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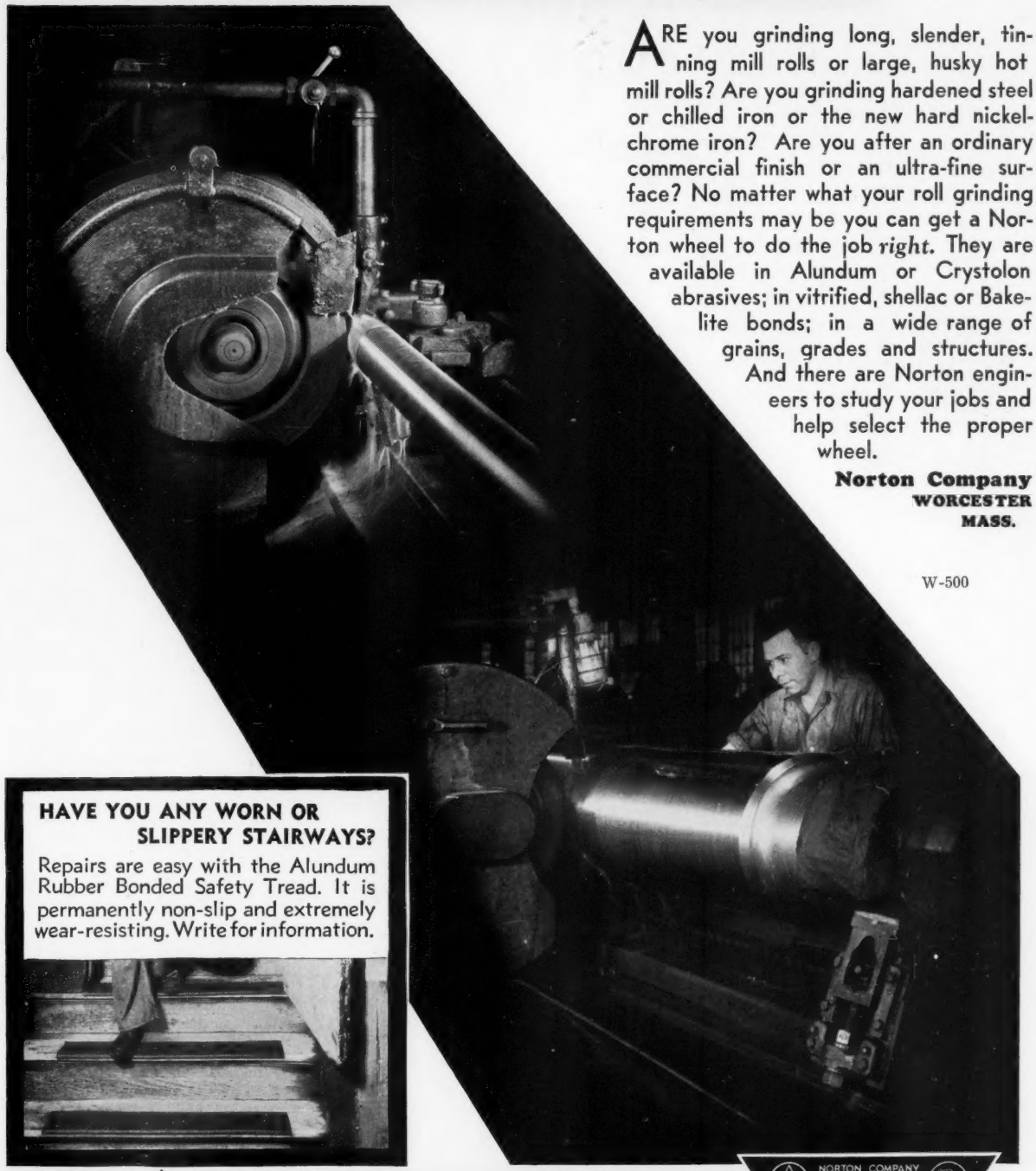

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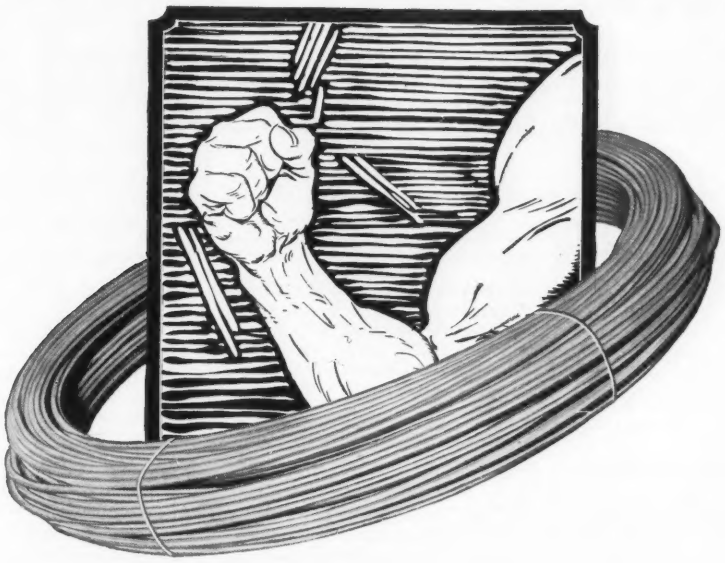

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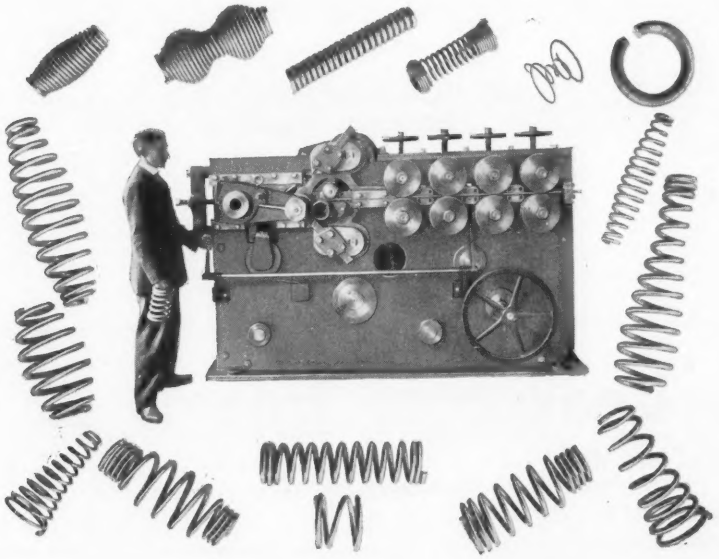

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DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 10 April 1935 No. 4

Designated as

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Contents

A Correlation of the Tensile Strength and Electrical Conductivity of Hard-Drawn Copper Wire with Preferred Orientation ..... By Prof. Roy Ward Drier 137

The Story of Wire, Part III ..... By Capt. Frank W. Bullock 141

A survey of the origin and development of the wire industry, together with a ten-year forecast on the future of the industry.

Spot Welding ..... By Lawrence Ferguson 143

A study of the welding peculiarities of 250 different combinations of metals. Which of these can and cannot be welded at the present time and methods of welding described.

Lubrication As Affected By Physical Properties of Lubricants ..... By Robert C. Williams 145

A study of lubricants developed for the drawing of wire.

The Embrittlement of Low Carbon Steel By Prof. F. C. Lea and R. N. Arnold 147

An analysis of the changes in the mechanical properties of steel having a low carbon content which occur as a result of quenching from temperatures up to 900 deg. C.

Sales Stimulators ..... By C. W. Geiger 148

Formula For the Determination of Total Feet Wound On Any Drum or Reel 151

Outstanding Personalities 152

Imports and Exports 154

A Review of Recent Wire Patents 155

'Round the World With the Wire Industry 157

Buyers' Guide 167-168

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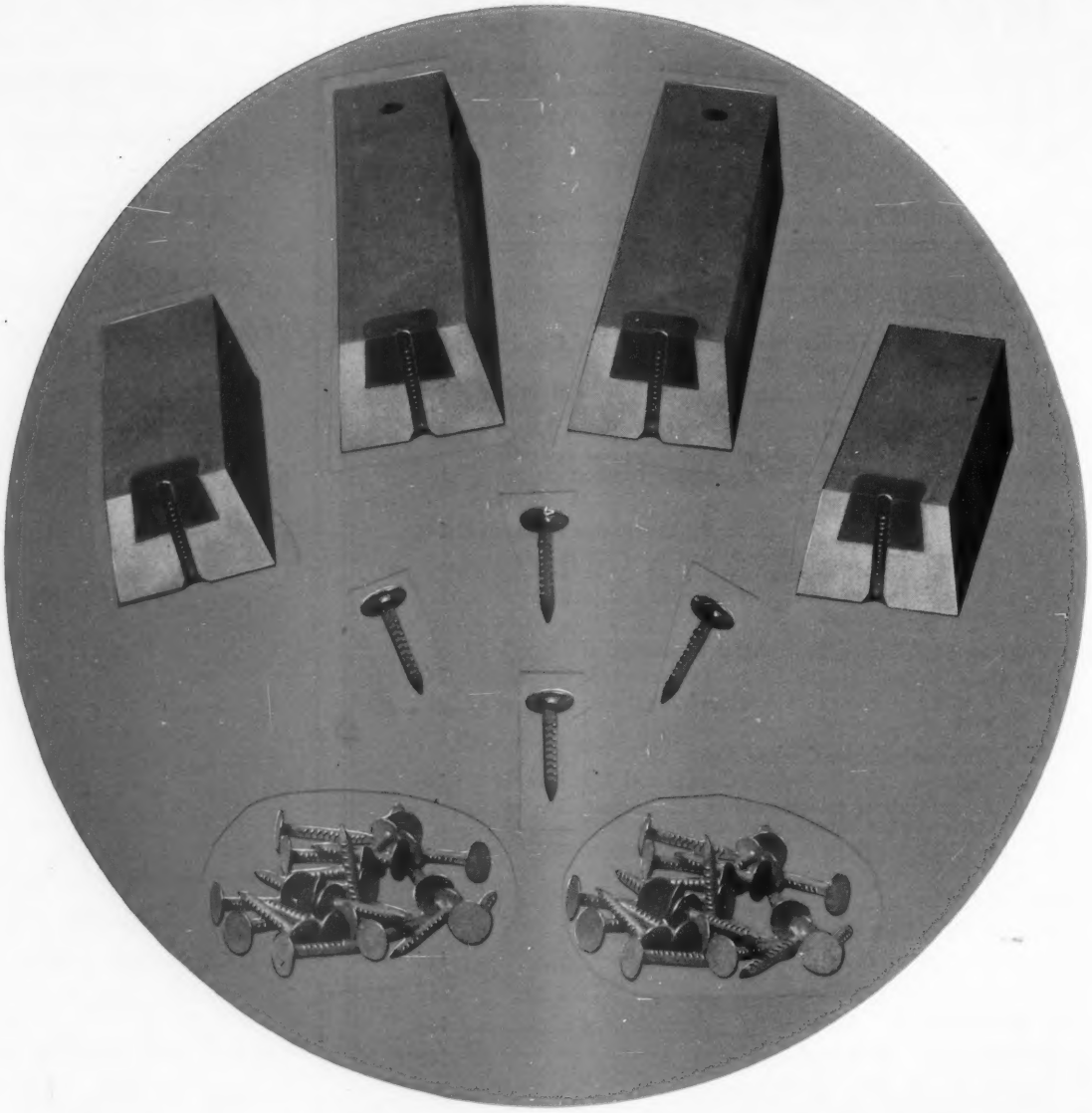

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Vol. 10 April 1935 No. 4

A Correlation of the Tensile Strength and Electrical Conductivity of Hard-Drawn Copper Wire With Preferred Orientation

PART I

By Roy Ward Drier

Associate Professor of Metallurgy Head of Division of Roentgenology
Michigan College of Mining and Technology, Houghton, Michigan

Abstract

Wire drawing is reviewed from antiquity to the present, with particular emphasis on present day drawing of copper wire. Unit cell orientation is deduced from micrographs and various types of X-ray spectra. These orientations are correlated with electrical conductivity and tensile strength, and explanations for the variations due to cold drawing are formulated. Similar correlation is done for copper wire, cold-drawn in various manners. Tensile strength does not vary appreciably but the electrical conductivity seems to be higher for wire drawn continuously than for wire whose direction of drawing is reversed. ✦ ✦ ✦ ✦ ✦ ✦

Introduction

TUBAL CAIN, the first "cunning artificer in metals," was in all probability the first producer of wire. Records of early Egypt mention metallic filaments or threads[1], some of which have been found to date back to 1700 B. C. The second book of Moses states that the sacerdotal robes of Aaron were decorated with "gold beaten into thin plates and cut into wires." Wire made in Nineveh in the ninth century B. C. is exhibited in the Kensington Museum. Wire is mentioned in the works of Homer and Pliny. In the Portici Museum are exhibited metal heads with metallic hair which were found in the excavations at Herculaneum.

✦ ✦ ✦

IN antiquity wire was produced by hammering out strips of metal. It was not until the fourteenth century A. D. that it was formed from rods drawn through metal dies. The histories of Augsberg and Nuremburg, Germany, mention the "drahtzieher," or wire drawer. Conrad Celtes, writing in the fourteenth century, mentions the hand-drawing of wire in a Nuremburg wire mill owned by a man called Rudolph. The first wire-drawing in France was done by Richard Archal in 1500, and some classes of wire are still known as "fil d'Archal"

✦ ✦ ✦

IN Great Britain the first machine-drawn wire was made in the middle of the sixteenth century, water power being used as the source of energy. It is interesting to note that two Saxons had to obtain permission from Queen Elizabeth to establish this mill and that for this privilege she was supplied with toilette pins from the mill.

✦ ✦ ✦

WIRE-DRAWING was introduced into the United States about 1830. Roebling and Sons established their business in 1849.

✦ ✦ ✦

Copper Wire Drawing

COPPER, which is to be drawn into wire, is first cast into bars about 4 by 4 in. in cross-sec-

The work presented constitutes a part of the author's thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Metallurgical Engineering at the Michigan College of Mining and Technology.

tion, about 5 ft. in length, and weighing between 200 and 250 lb. The molds are made of copper, and the ratio of mold weight to casting is usually about 5 to 1. Much of the copper drawn into wire is cast by hand. A good casting temperature for hand-cast wire bars is 1125° C. (2060° F.) The molds are set in 4 or 5 in. of water to expedite the cooling and thus keep the mold temperature from rising to a point where the casting and the mold fuse. In fact, practice has shown that it is advisable to keep the mold as near a temperature of 125° C. as possible all through the casting operation. Before each pour the interior of the mold is sprayed with a wash to keep the copper from adhering to the mold; this coating causes the splashings which strike the sides to drop back into the molten copper. It is good practice to remove the bar as soon as the copper has set.

✦ ✦ ✦

MOST wire bars are cast from primary copper, though the Western Electric Company reports satisfactory bars cast from remelted and refined clean secondary copper. [2]Dewald[3] reported improved wire and better drawing to sizes smaller than 24 B. & S. from a wire bar composed of small crystals rather than of medium or coarsely crystalline material. Discussions of this by Crampton[3] and by Schneider[3] seemed to indicate that grain-size in the wire bar has no effect on the final wire. It is difficult to see how the original grain size would have much final effect, for recrystallization occurring at some time during the hot-rolling completely destroys the original structure. It is conceivable that the power requirements for the rolling of finely crystalline and of coarsely crystalline materials might differ, and it might be deduced from general considerations that the more coarsely crystalline material would require less power; but it is the consensus of opinion that equally good wire can be drawn from wire bars differing only in grain-size—that is from either coarsely or finely crystalline stock.

✦ ✦ ✦

Comparison of Bars Cast Vertically and Horizontally

SCOTT and Dewald[4] compared copper wire bars vertically cast with those horizontally cast. They found that if the set face of a horizontally-cast bar were machined off, the bar responded to mill treatment more satisfactorily than the unmachined bars. They concluded that improved wire and wire drawing would result from the elimination of as much of the wrinkled surface as possible and from an increase of density, both of which would be accomplished by the use of a vertical mold. Their results showed that, in general, copper wire bars cast vertically were superior to those cast horizontally. They concluded that inasmuch as electrical conductivity varies directly with the density, the increase in density would result in an increase in conductivity, a conclusion which agreed with the findings of Masing and Hasse.[5]. Since the density after cold-drawing was the same, 8.91, regardless of the initial density or of method of casting, it does not necessarily follow that a method of casting denser copper would result in higher electrical conductivity. Scott and Dewald[4] showed an average increase in conductivity of 0.20 percent, a lower tensile strength, and a higher elongation for the vertically cast copper as compared with the horizontally cast. Skowronski, in his discussion of this work, suggested that the difference in the conductivity might well have been due to a variation in the oxygen content.

✦ ✦ ✦

ALL of the foregoing efforts toward improving wire bars were in the right direction, but did not result in any marked improvement. In 1920 a round-table discussion of wire bars and their processing led to the consideration of a possible method for eliminating the steps between the casting of the wire bar and its subsequent rolling to ½-in. rod.

Experiments in New Methods of Producing Copper Rod and Wire

VARIOUS schemes were conceived, such as extruding a ½-in. section from the molten bath at a rate which would permit cooling so that a solid rod would result. Another scheme was the tapping of the copper from near the bottom of the bath, through a water-cooled orifice. It was planned to exert a slight pull on the rod, by entering it in rolls placed close to the orifice. The procedure which seemed the most practical was that suggested by F. J. Kohlhaas. In accordance with his plan, which is now in the experimental stage, the copper is tapped from the molten bath into ⅝-in. grooves on a horizontal, revolving plate. The rate and temperature of pouring, the rate of travel of the plate, and the temperature of the plate are so adjusted that the rod is solid and can be shunted off the plate after it has completed approximately two-thirds of a revolution. Samples of this section were rolled to a 5/16-in. rod and then cold-drawn to No. 12 B. & S. wire, according to standard commercial practice.

✦ ✦ ✦

THE resulting wire fulfills all A. S. T. M. specifications. Of course many difficulties will be encountered and will have to be straightened out before such an innovation will be put in the regular flow-sheet; but when one considers the possibility of multiple-grooved plates, of controlled atmosphere in the pouring chamber, of placing the rolls and wire-drawing machines immediately adjacent to the grooved plate, and of the savings due to elimination of the pre-rolling heating and the rolling itself, this procedure promises to be the most outstanding improvement in wire-drawing practice in the last few decades.

✦ ✦ ✦

Present Commercial Practise

COMMERCIAL practice at present takes the wire bar, heats it to approximately 870° C. (1600°

F.), and then reduces it by a series of rolls to a rod of the desired size for drawing, usually 5/16-in. in diameter. The bars are advanced through the furnace through three distinct zones, are discharged at approximately 870°C. (1600° F.), and are then conveyed to the first set of rolls. A bar is reduced through a series of alternate squares and ovals to the desired size. A ¾-in. rod will have undergone 10 passes; a 5/16-in. rod 16. The reductions vary from 40 per cent in the bar section to 10 per cent in the finishing pass. Modern furnaces with single-line finishing will average from 12 to 14 tons of 5/16-in. rod per hour. The efficiency of modern plants is high. An installation such as that described will have a scrap loss of but 0.5 per cent.

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Some Causes of Defects in Copper Wire

SOME final defects in the wire can be traced to the rolling of the wire bar, but the practice is now so standardized that few defects are due to this operation.

✦ ✦ ✦

THE rod as it comes from the final roll is found to be coated with a black oxide which is removed by immersing for a half hour in a dilute sulphuric acid pickling solution. A concentration of 3 to 5 per cent acid and a temperature of 54° C. are optimum. Higher temperatures require higher acid concentrations. Adhering acid and scale are then removed by hosing with pressure water, and the rod is then dipped in a neutralizing solution which, besides the neutralizing ingredient, contains some agent designed to give the rod a coating that will prevent further oxidation.

✦ ✦ ✦

THE above operations are all preliminary to the actual wire-drawing. The rod is now in a softened condition ready for drawing. It can be reduced to the desired size by either of two processes; by continuous drawing through a series of dies of decreasing diameter, or by passing through the same dies, singly, the direction of drawing being reversed after each pass. This single-block method necessitates coiling the wire after each pass. The final section of this thesis discusses the effects of alternating the direction of drawing.

✦ ✦ ✦

Rate of Reduction Rod to Wire

THOUGH reductions of 50 per cent in cross-section are possibbe, the accepted reduction in commercial wire-drawing is slightly more than 20 per cent per die. Coarse and medium-fine wire are drawn through dies of chilled cast iron, hard steel, tungsten carbide, or tantalum carbide. The finer sizes of wires are drawn through diamond dies. A detailed treatment of dies, lubrication, power, and other phases of wire-drawing technique is deferred for the present.

Part II. Ultimate structure, electrical conductivity, tensile strength, with micrographs of experiments will be published in the May issue of Wire and Wire Products.

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AS is the case in the writing of most theses, it is a difficult task to delineate the exact inspiration or suggestion or aid given by any one person; but for all of these the author acknowledges a pleasurable indebtedness to Professors A. T. Sweet and C. T. Eddy, and to Mr. H. L. Walker. The author wishes to thank the Quincy Mining Company and F. J. Foley, of the Foley Wire Mill, for samples of Copper and copper wire and for their kindness in interrupting their regular routine to draw some of the wires used in the prosecuting of this research.

✦ ✦ ✦

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SUBSEQUENT installments include the following subjects: Ultimate Structure, Electrical Conductivity, Tensile Strength; Samples, Diffraction, Resistivity Measurements, Resistance to Deformation Correlated with Cell Orientation, Electrical Conductivity Correlated with Cell Orientation, Electrical Conductivity of Copper Wire Drawn in Various Ways, Energetics of Unit Cell Orientation.

1935
Annual Meeting
of the
Wire Association

Will be held at Chicago, Ill.,
SEPT. 30-OCTOBER 4
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in association with the

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Wire Association
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Richard E. Brown, Secretary
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The Story of Wire

By Captain Frank W. Bullock

Signal Corps, U. S. Army

A survey of the origin and development of the wire industry, together with an analysis of the conditions creating wire products markets and a ten-year forecast on the future of the wire industry. An original research prepared for the Harvard Graduate School of Business Administration. Part III.

Organization, Trade Groupings, Integration

THE picture of the wire industry today is not complete without some description of its organization. The history of the development of the wire industry in the United States has been characterized by a succession of combinations, amalgamations and integrations, concerning which we have purposely avoided detailed discussion. Mr. Kenneth B. Lewis[1] divides the wire mills of the country into four classes, which may be summarized as follows:

1. **Mills producing the common (large tonnage) products such as fencing, nails, bail ties, and plain hard drawn copper wires in larger sizes.**
2. **Mills producing specialties of relatively simple nature, such as wire rope, messenger strand, screw stock, etc., for local markets.**
3. **Mills producing specialties requiring particular skill in their fabrication, such as springs, special alloy wires, card and heddle wire, needles, cold drawn shapes, magnet and resistance wires, instrument wires, insulated wire and electrical cables. These mills produce in limited tonnages, either drawing their own wire or purchasing special wires made to their own specifications.**
4. **Mills which are departments of larger manufacturing plants, and whose products are largely absorbed in the finished products of such plants.**

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THIS classification omits any mention of the larger, integrated enterprises of which The American Steel and Wire Company, John A. Roebling's Sons Inc., Anaconda Wire and Cable Co. and General Cable are typical. Mills of this type commonly include within their organizations all of the functional classifications mentioned by Mr. Lewis. Such mills in many instances carry the process all the way from the raw ore to the finished product in which wire is but a component.

[1] "The Wire Drawing Industry", (address delivered 1930).

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UNTIL the late war, American wire mills were working examples of the application of the time honored doctrine of rugged individualism. A universal belief in the old "trade secret" fiction amounted to almost a religion in the industry. The pressure of war requirements, assisted by the hard boiled attitude of the War Industries Board, showed wire mill executives and technicians the fallacy of their self-sufficient attitude and from that experience emerged the beginning of cooperative organization in the wire industry. "War Service Committees" organized by individual enterprises and related industrial groups for the purpose of speeding up wartime production proved of immense value not only in the exchange of technical information but in the detection and correction of unethical trade practices such as falsification of cost records affecting public contracts and the abuse of priority regulations.

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THE post war years saw an increasing tendency in the direction of cooperative organization in the wire industry. It is true that prior to 1924 the initiative was for the most part supplied from sources outside the wire industry proper. For example, in 1920 the Iron and Steel Institute opened its membership to some of the so-called "independent" manufacturers of steel wire. A year later the "Machine Tool Association" opened its membership to manufacturers of wire forming and fabricating machinery. In 1924 the "National Electrical Manufacturers' Association" invited certain manufacturers of non-ferrous and insulated wires to participate in its activities as members. Unfortunately these affiliation provided no common meeting ground for the exchange of ideas by wire mill executives and technicians. In fact they tended to perpetuate the unhealthy and outworn fiction of the "trade secret".

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All Wire Mills Have Common Basic Operations

ALTHOUGH the manufacture of wire and wire products is on the one hand closely integrated with the iron and steel industry, and on the other with the electrical manufacturing industry, the fact remains that wire mills, whether working in steel, non-ferrous metals or alloys, employ certain processes and perform certain basic operations common to all, which impart to the making of wire what may be termed an "industrial individuality", quite distinct from the industries to which it is most intimately related. This condition served to make apparent the fact that there existed an urgent and unsatisfied need for some organization which could establish a means by which wire manufacturers might meet for the exchange of ideas and the solution of production problems peculiar to the wire industry.

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AFTER an exhaustive study of the peculiar conditions af-

fecting the wire industry, **Mr. Richard E. Brown,** Publisher of "Wire and Wire Products", convinced of the urgency of the need, in 1929 conceived the idea of forming an independent association of wire mill executives through which they would be afforded an opportunity to exchange information relating to problems of production, the solution of which would react to the advantage of the wire industry as a whole. Accordingly in October of 1929, Mr. Brown arranged for a meeting of wire mill production executives to be held in June of the following year at Buffalo, N. Y., in conjunction with the regular annual meeting of the Society of Iron and Steel Electrical Engineers.

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The Wire Association

AT this meeting, The **"Wire Association"** came into being. Although unheralded and accompanied by no front page publicity, this event marked the beginning of a new era in the history of the wire industry—for the first time wire mill executives and production men became "industrially conscious". In 1932 the Wire Association having demonstrated its usefulness entered into an affiliation with the National Metal Trades Congress in which the American Society for Steel Treating, now the American Metals Society exercised the dominant influence. This arrangement was made as a result of the community of interests and cordial relations existing between the two organizations, and has proved mutually advantageous.

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THE character and activities of the Wire Association are best described in the words of its founders as set forth in its application for incorporation:

> **"The Wire Association is a non-profit organization of wire mill executives, superintendents and foremen. It also includes plant engineers, traffic men, credit men, salesmen, and all others engaged in the wire industry, together with manufacturers, and other interested persons who have something to sell to the wire mill or some service to render for pay.**
>
> **Its specific purpose is to improve production methods and afford a clearing house for ideas on management problems, technical problems, and research work in all phases of practical wire drawing and wire working, and to develop and maintain friendly relations among the members."**

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THE functions of the Association are defined as follows:

"1. The maintenance of the Association headquarters as a central clearing house for information and data of all kinds which may be of interest to members.

2 The exchange of ideas on processes of production including machinery, technical processes, etc.

3. The establishment and maintenance of friendly relations among the members of the association and the development of sectional and national meetings to discuss matters of mutual interest.

4. Studies of production methods and analysis of production costs.

5. Developments in the use of new materials and new applications of existing materials and by-products.

6. Research and collection of information on personnel management, including such factors as labor turnover, seasonal changes in the demand for employes, wage scales, etc.

7. Standardization and simplification as a means for the effective elimination of waste, including:

8. Such other subjects as may be determined upon."

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THE launching of the **"Wire Association** was timed to respond to a long felt need, and its growth and the success of its undertakings have been spectacular. Its membership includes practically all of the "independent" wire mills

(*Please turn to page 163*)

THE WIRE ASSOCIATION
Special Planning Committee

Information Form B. - Capacity Analysis

Name of Company: _____

Office Address: _____

Plant: _____

(Please submit separate Form for each plant operated.)

	Yes or No	*Normal Monthly Capacity Unit —	Normal Operating Time - Hours Per Week	*Product Consumed within Own Organization	*Product Marketed Directly	Reserve Capacity over (2), (3), (4), & (5)
BASIC OPERATIONS:	(1)	(2)	(3)	(4)	(5)	(6)
A. Steel and Ferro Alloys						
1. Rod Rolling						
2. Wire Drawing						
3. Tinning						
4. Galvanizing						
B. Copper and Non-Ferrous Metals						
1. Rod Rolling						
2. Wire Drawing						
3. Tinning						
FABRICATING OPERATIONS:						
A. and B.						
1. Stranding						
2. Bunching						
3. Rubber Milling						
4. Extruding						
5. Stripping						
6. Braiding						
7. Weatherproofing						
8. Twinning						
SPECIAL OPERATIONS:						

Remarks: (Use reverse side.)

Report as of _____ 193 __. By: _____

Title: _____

*NOTE: Expressed in customary units used by your plant. Figures under (4) and (5) may be expressed in same units as (2).

Spot Welding

K. B. WHITE
Member of Technical Staff, Bell Telephone Laboratories, Inc.
New York, N. Y.

A study of the welding peculiarities of 250 different combinations of metals. Which of these can and cannot be welded at the present time and methods of welding described.

THE application of spot welding to the diversified product of the Bell System has required considerable research and development. To weld two pieces of iron together is quite simple with ordinary precautions, but it has been found very difficult to produce satisfactory welds between some of the diverse metals used in telephone apparatus. Each combination of metals may require different welding conditions, and to determine the optimum treatment has necessitated extensive study. During the course of some of these studies the welding peculiarities of 250 different combinations of metals have been examined. Which of these can and which cannot be welded at the present time are shown in Figure 1.

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Usual Method of Making a Spot Weld

THE usual method of making a spot weld is indicated by Figure 2. A large localized current is passed through the parts to be welded between two electrodes. Under the influence of this current, the metal pieces heat up rapidly in a small region between the electrode tips. At the right moment, the pressure applied completes the weld. Welding machines, largely automatic in their operation, have been developed, which regulate and control such variables as pressure, duration and strength of current, and the sequence of pressure and current flow. Apart from these variables controlled by the welding machine, however, there are other factors such as size, shape and composition of the pieces to be welded, contact resistance, and distribution of current. The nature and strength of the weld obtained depend not only on how well these variables are adjusted to each other, but also on the strength of the materials after the heat treatment caused by the welding process, the degree of alloying of the materials welded, the strength of the alloy formed by welding, the cleanness of the pieces, and the size of the weld.

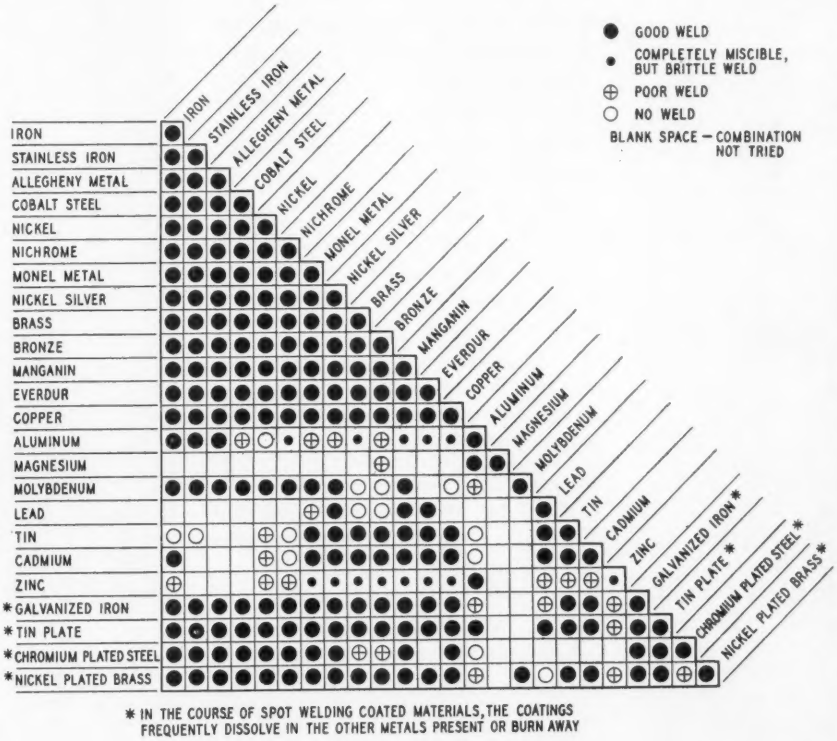

Fig. 1—The welding characteristics of some 250 combinations of metals have been studied in the Laboratories.

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Clean Metal Essential for Good Spot Welds

THE first essential for making good spot welds is to work only with clean metal parts. The best technique is practically useless against grease, dirt, or scale. The higher and uneven contact resistance between unclean parts greatly increases the likelihood of having the bulk of the welding current surge through whatever small area happens to weld first. Scale and dirt also mix in the weld material, making it brittle and porous.

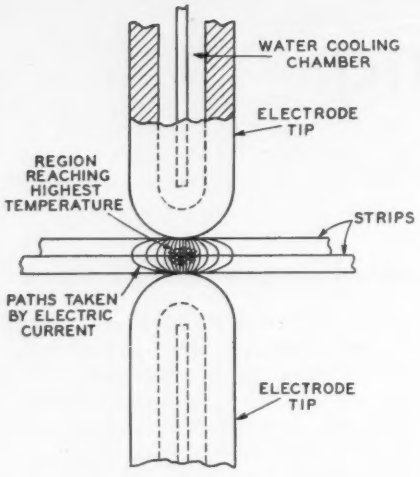
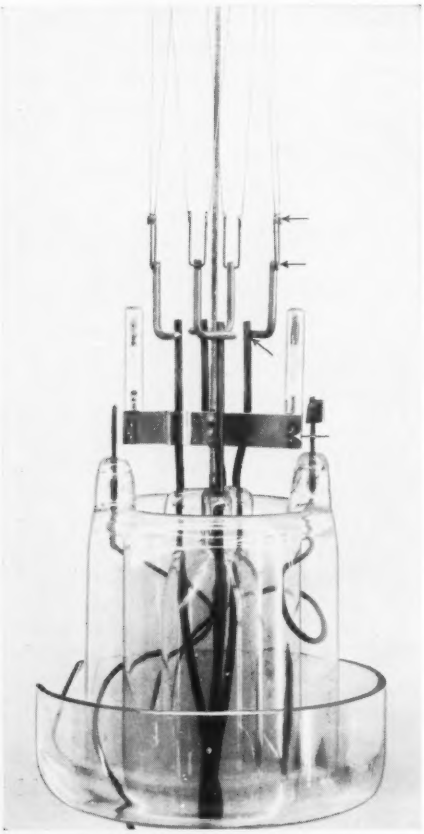


Fig. 2—In a spot weld the heating is localized over a very small area. ✦ ✦ ✦

Choice of Materials for Welding

ANOTHER essential detail is the choice of an electrode tip material that will not alloy with, or adhere to, the pieces being welded, and that will aid in keeping the outside surface of the welded pieces as cool as possible. Large scale commercial use also frequently requires a material that does not soften or lose its shape during continuous operation. In normal practice, for welding high resistance materials such as iron, nickel, nichrome, and nickel-silver, electrode tips of copper are suitable. Where greater strength or longer life is required, however, a copper rich copper-tungsten alloy is advisable. For welds between low resistance materials such as copper or aluminum, so high a welding current must be used that the electrode tips themselves become very hot. Under this condition, tungsten tips are best because they do not easily alloy or weld at ordinary welding temperatures.



Spot welding is widely used to weld filaments and supporting wires in vacuum tubes. ✦

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Welding Two Strips of Radically Different Thicknesses

TWO strips of metal of radically different thickness present a problem in spot welding which is solved by the control of current distribution afforded by the size of electrode tips used. Since current density is greater near a smaller tip, and cooling by conduction is less, a small electrode tip is used against the thin piece to be welded and a large one is placed against the thick piece. This same control of current density and cooling by conduction may be used also for welding a material of high electrical resistance to one of low resistance or for welding a low melting point material to one having a high melting point. The small electrode tip is here placed against the low resistance or the high melting point material. For these latter problems, however, there is another solution, called projection welding, which may be more satisfactory.

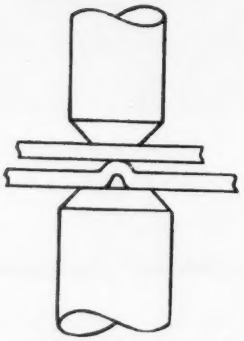
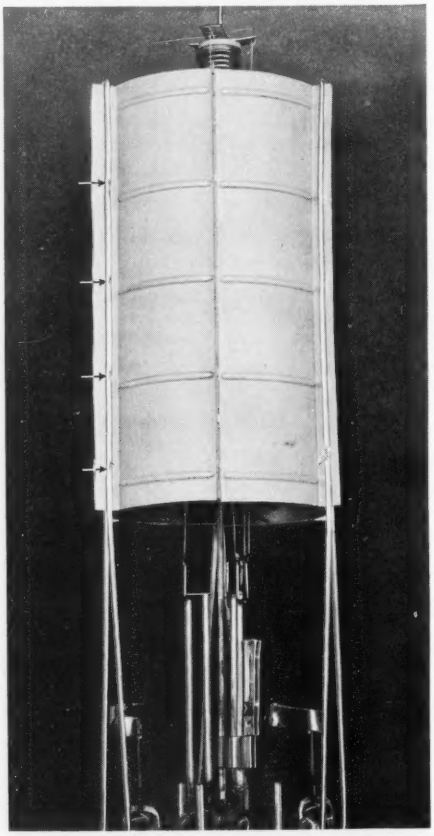


Fig. 3—In a projection weld the area of heating is further localized by a small projection formed in one of the parts before the weld is made. ✦

Projection Welding

PROJECTION welding receives its name from the small bump or projection raised between the



The supporting wires of the cylindrical plates of certain types of vacuum tubes are run the full length of the plate, and the sections of the plate are welded by the same operation that welds the supports to them. ✦ ✦ ✦

(*Please turn to page 156*)

Lubrication As Affected By Physical Properties of Lubricants

By Robert C. Williams
Chief Chemist, The Ironsides Company, Columbus, Ohio

This article was prepared for presentation at the meeting of the American Chemical Society in September, 1934. Dealing with the experimental laboratory stage of this development, the procedure and data are, obviously, not to be interpreted in the light of widely differing, practical wire drawing operations. Work on the practical application of this development is in progress.

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IN a study of lubrication as related to the process of drawing wire, the utility of various solid lubricants was investigated. The present report deals with a certain class of solid lubricants, which, when subjected to a shearing action between surfaces under considerable pressure, reduce friction to a remarkable extent. The results presented here are somewhat related to earlier work by Hardy and Doubleday (1). They found the coefficient of static friction to decrease to zero at the melting point of solid lubricants and believe that a film of rather appreciable and critical thickness was responsible for this action. The finding, in itself, was not of great interest to Hardy, and he dismissed this aspect of his work.

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Experimental Procedure

THE apparatus used in this investigation was identical with that described previously (4) and consisted briefly in an experimental set-up for drawing wire where the total pull on the die was measured. The total pull equals the pull required to produce deformation of the wire during the reduction in diameter plus the pull required to overcome friction.

THE die pull was practically independent of the speed of drawing within limits as reported previously (4), and these experiments were carried out with a drawing speed of 30 cm. (11.8 inches) per minute. In order to simplify the calculations of the coefficient of friction and the pull required to overcome friction, no back pull was applied to the wire as in the earlier work. Care was taken, however, to provide axial extrance of the die by the wire. The lubricants were applied to the wire (previously cleaned with acetone) by gently rubbing it with a piece of the lubricant or by swabbing it with the liquid or molten material. Wire which was properly cleaned could not be drawn without seizure through a clean die. The results were reproducible within ± 5 per cent.

IN a study of lubricants and friction, one ordinarily presents the results in terms of the co-efficients of friction. Lewis (2), in a series of articles on the wire-drawing die, develops a plausible equation relating the total die pull to the pull required to reduce the wire to overcome friction:

Die pull = (m.y.p.) (A — a) [1 + (cotan $\theta/$) (cf.)] where m.y.p. = mean yield point of the wire and is considered to be the ultimate strength of the wire before drawing

A — a = difference in cross-sectional area before and after drawing

cotan $\theta/2$ = cotangent of the "half-angle" of the die (the angle of the throat of the die is bisected to obtain the half angle)

cf. = coefficient of friction

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THE product of the first two numbers of the equation represents the component of the pull which does the useful work of deforming the metal. The final member represents the frictional component of the pull, and, when the die has a cylindrical bearing, Lewis has devised a modification of the cotangent value to include friction in the cylindrical bearing.

TABLE 1. RESULTS ON DRAWING WIRE THROUGH AN 0.0225-INCH DIAMETER TUNGSTEN CARBIDE DIE AT 30 CENTIMETERS (11.8 INCHES) PER MINUTE

Lubricant[1]	0.0253-Inch Soft Copper Wire			0.0250-Inch Annealed 18-8 Stainless Steel Wire		
	Required pull Pounds	Coefficient of friction	Work lost due to friction %	Required pull Pounds	Coefficient of friction	Work lost due to friction %
Mineral oil (Saybolt viscosity, 100 seconds at 100° F.)	8.5	0.21	57.3	20.4	0.23	59.5
Mineral oil (Saybolt viscosity, 160 seconds at 210° F.)	10.0	0.28	63.7	23.3	0.29	64.6
Oleic acid, U. S. P.	9.0	0.23	59.7	25.8	0.34	68.0
Stearic acid,[1] C. P.	7.0	0.15	48.1	13.7	0.10	39.8
Paraffin wax (m. p., 57-58° C. or 134.6-136.4° F.)	5.8	0.095	37.4	15.4	0.14	46.4
Beeswax (m. p., 60.5-62° C. or 140.9-143.6° F.)	5.6	0.086	35.2	11.9	0.07	30.7
Halowax 1014[1] (m. p., 133-139° C. or 271.4-282.2° F.)	6.9	0.14	47.4	17.9	0.19	53.9
Aroclor No. 1254[2] (Saybolt viscosity, 46-47.7 seconds at 210° F.)	10.0	0.28	63.7	22.9	0.28	64.0
Petroleum asphalt (m. p., 77° C. or 170.6° F.)	14.9	0.49	75.6	...	...	...
None (wire may break)	17	0.58	78.6	40	0.61	79.4

[1] Lubricants marked [1] were applied when molten and were allowed to cool before drawing.
[2] A chlorinated diphenyl, liquid at room temperature; the Halowax is a waxlike chlorinated naphthalene.

IN these experiments the die used had no cylindrical bearing of any consequence. The die angle of 18° (the half-angle is therefore 9°) tapered gradually through the desired gage into a relief angle at the end. The cotangent used in these calculations is therefore that for a 9° angle (6.314). Soft copper wire and 18-8 stainless steel wire were drawn.

✦ ✦ ✦

THE tensile strength value used for m.y.p. of the soft copper wire used here (0.0253 inch in diameter), as determined experimentally, was 17.4 pounds. Calculated to the basis of one square inch, the value is 34,600 pounds which compares favorably with the value of 35,000 pounds ± 5,000 for annealed copper as given in the National Metals Handbook (3). The reduction of the copper wire was to a diameter of 0.0225 inch, so that the value for (A—a) was 0.000105 square inch.

✦ ✦ ✦

THE tensile strength of the 18-8 wire of 0.0250 inch diameter was 43.75 pounds. This corresponds to a value of 89,200 pounds per square inch. This result indicated that this wire was not completely annealed, as the handbook (3) records a range of 70,000 to 80,000 pounds per square inch as the tensile strength for annealed 18-8 wire. The reduction of the 18-8 wire was also to 0.0225 inch in diameter so that (A — a) equals 0.0000925 square inch.

✦ ✦ ✦

THE experimentally determined values for tensile strength were used in the equation for m. y. p.

✦ ✦ ✦

THE deformational work in foot-pounds required for drawing one pound of wire may be calculated by multiplying the product of (m. y. p.) and (A — a) by the number of feet of wire in one pound. The fraction of the work lost due to friction is found by dividing the difference between the observed die pull and the calculated deformational pull by the observed die pull.

THE results are presented in Table I. Data for some conventional lubricants are included for comparative purposes. These data have been selected from a large number of experiments involving waxes and waxlike substances. Beeswax was found to be the most effective lubricant under the experimental conditions outlined above. Copper oleate, ceresin wax, and various blended waxes were in the same range of effectiveness as paraffin and beeswax. When the temperature of the die was artificially raised above the melting point of any wax in question, the coefficient of friction rose to values closely corresponding to those for mineral oils or other liquid lubricants at the same temperature. It is apparent that the lubricant must enter the region of great pressure in the die as a solid rather than as a liquid, as in the case of the heated die, if enhanced lubrication is to be effected.

✦ ✦ ✦

THE waxes of higher melting point became effective at temperatures approaching their melting points; carnauba wax, for example, at a die temperature of about 70° C. (158° F.) was comparable in effectiveness with beeswax under ordinary conditions. Halowax, a chlorinated naphthalene, being tough instead of exceedingly brittle at room temperature, was quite effective under ordinary conditions.

✦ ✦ ✦

IT appears that the lubricant must be transformed into a fairly mobile liquid under the conditions of temperature and pressure at the wire-die interface. Asphalt, as shown in Table I, was rather poor as a lubricant, and it is not very mobile somewhat above its flowing point. A very uniform, visible film of asphalt covered the wire as it came out of the die. Several low-temperature (60° to 100° C. or 140° to 212° F.) thermoplastic resins were tested, but the wire could not be drawn because of breakage unless the die or wire was heated. Good adhesion of the wax to the wire or die is apparently of great importance, for, when beeswax was applied to a wire that was previously wetted with a mineral oil, the coefficient of friction obtained was practically the same as that for the oil. On the other hand, when mineral oil was applied to the waxed wire, there was little effect on the coefficient of friction if the test was carried out immediately. Strong adhesion apparently permits a film of wax of relatively great thickness to remain on the wire until the region of great pressure is reached in the die where the wax melts and, being prevented from exuding at the entrance of the die by the solid wax, acts mainly as a "fluid film" lubricant.

✦ ✦ ✦

Conclusions

THESE considerations lead to at least three conditions which must apparently be satisfied to observe this enhanced lubrication in wire drawing: (1) The lubricant must adhere strongly to at least one of the surfaces—the wire or the die; (2) the lubricant must be solid prior to being subjected to the relative shearing of the surfaces to be lubricated; and (3) the lubricant must melt or be transformed to a fairly mobile liquid between the surfaces while shearing takes place.

✦ ✦ ✦

THE action appears to be analogous to that occurring when a sled or skate slides on ice. Polar explorers have observed that sledges are pulled with considerable difficulty during the coldest polar weather, because the frictional heat and pressure are insufficient to melt the ice under the runner. An observable greater die pull is registered when the wire-drawing machine is started after it has been idle for some time when using a wax lubricant.

✦ ✦ ✦

THE coefficient of friction with a solid lubricant that meets the conditions outlined above depends largely, it is believed, on the

(*Please turn to page 160*)

The Embrittlement of Low Carbon Steel

An analysis of the changes in the mechanical properties of steel having a low carbon content which occur as a result of quenching from temperatures up to 900 deg. C. ✦ ✦ ✦

A PAPER, entitled "The Embrittlement of Low-Carbon Steel," recently submitted to the Institution of Mechanical Engineers by Professor F. C. Lea and Mr. R. N. Arnold, deals with those changes in the mechanical properties of steel having a low-carbon content, which occur as a result of quenching from temperatures up to 900 deg. C. The authors state that failures which are difficult to explain occur frequently in engineering practice, especially in steels of this type, and that two distinct types of brittleness have been observed. One is brought about by ageing at atmospheric temperature after rapid cooling from temperatures between 550 deg. C. and 850 deg. C., while the other is the instantaneous result of quenching from temperatures in the region of 750 deg. C. In certain cases both influences may act in conjunction and promote excessive brittleness. Normally, low-carbon steel is not subjected to heat treatment after manufacture, but conditions which may lead to embrittlement appear to be possible in many engineering processes, such as case-hardening, riveting and work from the anvil suddenly cooled by quenching in the bosh. The work described in the present paper was carried out in order, if possible, to throw some light upon such failures. The research was conducted on four commercial steels obtained from Sheffield steelmakers; these were stated to have the percentage compositions shown in Table I. Each steel was first normalised by heating for 15 minutes at the temperature indicated in Table I, and then cooling in air.

✦ ✦ ✦

TEST pieces of each steel were water-quenched from 450 deg. C. and 650 deg. C., and set aside to age unstressed at atmospheric temperature. Only small differences due to the treatment at 450 deg. C. were detected, and, therefore, only the results obtained by quenching from 650 deg. C. have been included. The only steel which shows serious embrittlement after quenching from 650 deg. C. is AS 5, which gave an impact value of 92.5 ft.-lb. immediately after quenching, and of 18.5 ft.-lb. after ageing for 27 days. Steel A 1 also shows a fall in impact resistance, but steels A 3 and AS 8 show little change. A nearly constant Izod value for each steel is reached in approximately 30 days.

TABLE I.

Steel No.	C.	Si.	S.	P.	Mn.	Norm. Temp. deg. C.
AS 5	0.12		0.030	0.014	0.43	900
A 1	0.16	0.080	0.024	0.024	0.76 0.77	880
A 3	0.29	0.110	0.024	0.037	0.73	860
AS 8	0.46	0.184	0.032	0.027	0.73	790

✦ ✦ ✦

WHILE this ageing results in decreased ductility and resistance to impact, the hardness, tensile strength and fatigue limit are increased. Stress-strain curves obtained from the tensile tests showed, in the case of steel AS 5, that ageing is intensely rapid during the initial period, the strength increasing by 3 tons per square inch during the first 4 hours. After 2 months, the tensile strength showed a total increase of 44 per cent. A slight ageing effect on the tensile strength is also shown in steel AS 8, but the rise is only 0.5 ton per square inch. The remaining steels increased in tensile strength by an amount which diminished as the carbon content increased. The increase in hardness is approximately the same as that in tensile strength. Wöhler fatigue tests conducted on steel AS 5 showed that an increase of some 4 tons per square inch in the half range of stress was obtained as the result of ageing. Sankey bend tests showed that steel AS 5, when embrittled, could only withstand 25 bends before fracture. In the normalised condition, 54 bends were required. The energy expended was 1,475 ft.-lb. and 2,350 ft.-lb. respectively. The magnitude of the change due to quenching and ageing is dependent on the carbon content of the steel, the lower carbon showing the more pronounced effect.

✦ ✦ ✦

WATER-quenching from temperatures up to 700 deg. C. appears to have little influence on the initial impact value of the steels. When quenched in the region of 750 deg. C., in the vicinity of the A_1 change point, however, an instantaneous drop in the impact value is observed in all the steels, while in the case of steels AS 5, A 1 and A 3 distinct recovery appears when these materials are quenched at approximately 800 deg. C.,

(*Please turn to page 160*)

Sales Stimulators

By C. W. Geiger, San Francisco, Calif.

Many Wire Companies Make Elaborate Displays at the Annual Meeting of the Western Division of the American Mining Congress at San Francisco and at the California State Fair.

THE first national exposition of mining machinery and supplies was made in conjunction with the Annual meeting of the Western Division of the American Mining Congress in The Palace Hotel in San Francisco September 24 to 29.

✦ ✦ ✦

THE San Francisco convention of the mining congress, mining authorities assert was the most vitally important to the industry in many years. The program was an interesting one, participated in by men who are leaders in their industries. The exposition of mining machinery and supplies completed the picture.

✦ ✦ ✦

PERHAPS the most interesting display of wire and wire products was made by The Columbia Steel Company, United States Steel Corporation Subsidiary in conjunction with American Steel and Wire Company. This display which was fabricated and painted from wall board, wood, parchment, papier machè, was painted and modelled by artists of Nelson Display Company. The lighting and mechanical effects which were worked out by this same company, carried out forcefully the general effect of depth and prespective and gave a most realistic impression of heat waves and flowing metal.

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THE first scene in this display showed a blast furnace in operation; the second gave an excellent representation of the tapping of an open-hearth furnace; the third scene represented the metal as being poured from the ladle into ingot molds and the last scene showed an ingot entering the rolling mill for the first breaking down process.

✦ ✦ ✦

THE Columbia Steel Company booth was in charge of Mr. Bennett, Advertising Manager and included panels of electrical wires, samples of lock coil track cables for tramways and a very extensive assortment of wire rope and samples. One of the interesting features was a two-foot section of the three-inch diameter lock coil tramway cable used in the main cableway at Boulder Dam.

✦ ✦ ✦

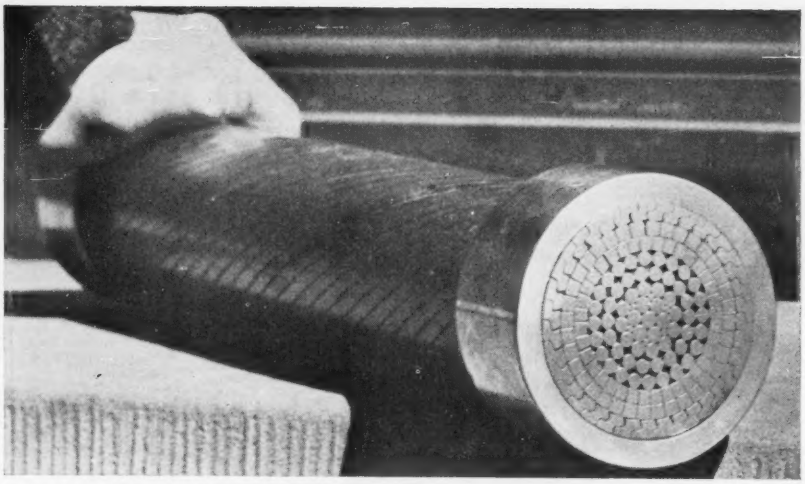
THE Columbia Steel Company is the Pacific Coast Distributor for products of the United States Steel Corporation subsidiaries,

SAN FRANCISCO
MINING CHEMICALS
COLUMBIA STEEL COMPANY
Serving the West with Products of the United States Steel Corporation Subsidiaries
COLUMBIA STEEL CO
Western mills make Columbia Steel for Western markets.
US STEEL
DURICLIME PIPE

Columbia Steel Company Exhibit at American Mining Congress.

✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

these products including wires of all kinds, wire fences and netting, barbed wire, wire rope, aerial tramways, bale ties, hay stacker rope, etc. The Columbia Steel Company is general contractor for the entire superstructure, including suspension cables of the great $77,000,000.00 San Francisco - Oakland Bay Bridge.



Section of 3 inch Diameter Lock Coil Tramway Cable used in main cableway at Boulder Dam. General Cable Corp. Exhibit.

✦ ✦ ✦

THE John A. Roebling's Sons Company of California, who is the general contractor for the suspension cables and accessories for the $35,000,000.00 Golden Gate Bridge had a display of their products which included a panel of pieces of various types of wire rope for mine hoisting and the attachments; steel screening and samples of insulated coils for electrical purposes and various types of lead covered electrical cables, telephone types of wire rope for mine hoisting and the attachments; also steel screening and a group of samples of insulated coils for electrical purposes and various types of lead covered electrical cables, telephone cables, magnet wire and other insulated cables used in the Mining Industry.

✦ ✦ ✦

THE General Cable Corporation displayed an extensive assortment of high voltage transmission cables, underground insulated lead sheath cables, submarine cables, rubber covered wire and cables and cable terminals. The display was in charge of Mr. A. D. Williams, District Manager with headquarters at 30 Otis street San Francisco. A great deal of interest was taken in the section of the transmission cable 500,000 c. m. diameter cable now being installed on the 287,000 volt transmission line that will carry electrical power from Boulder Dam power plants to Los Angeles. A section of the transmission line cable for the Pennsylvania Railroad connecting Jersey City and Washington was also displayed.

✦ ✦ ✦

OTHER displays of wire and wire products were made by E. H. Edwards Company, A. Leschen & Sons Rope Company, Hazard Wire Rope Company, W. S. Tyler Company, American Cable Company. The W. S. Tyler Company display included a number of 12 inch square sections of press lock crimp wire screen for use in gravel and rock plants, and several sections of ton-Cap screen for mining purposes.

(*Please turn to page 162*)

Columbia Steel Company Display at California State Fair ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

Formula For the Determination of Total Feet Wound on Any Drum or Reel

Mr. C. D. Meals, Wire Rope Engineer, The B. Greening Wire Co., Ltd., in connection with the article on pages 42 and 43 of the January issue relative to the amount of rope that a drum or reel will hold, states that similar formula are given in quite a few wire rope manufacturers' catalogues, advising as follows:

The formula per your article may be written as—

$$C = \frac{.3\ Lh\ (S + h)}{d^2} \quad —(1)$$

Voigtlander in Union Wire Rope Corp. catalogue of 1929 gives it as—

$$C = \frac{.283\ Lh\ (S + h)}{d^2} \quad — (2)$$

The A. Leschen & Sons Rope Co. give it in their catalogue essentially as—

$$C = \frac{.262\ Lh\ (S + h)}{d^2} \quad — (3)$$

This appeared initially, to the writer's knowledge, in their 1914 catalogue; it may have been given in an earlier edition.

The late Wm. Hewitt gave the following formula in the 1905 edition of the Old Trenton Iron Co.'s catalogue as—

$$C = \frac{.0655\ (D^2 — S^2)\ L}{d^2} \quad —(4)$$

in which

$$D = S + 2h$$

Formulae (3) and (4) are identical, which can be proven algebraically, as follows—

$$D^2 = S^2 + 4Sh + 4h^2$$

$$D^2 — S^2 = 4Sh + 4h^2, \text{ whence}$$

$$C = \frac{0655\ (4Sh + 4h^2)\ L}{d^2}$$

$$L = \frac{.0655 \times 4h\ (S + H)\ L}{d^2}$$

$$= \frac{262\ Lh\ (S + h)}{d^2}$$

which is formula (3)

The derivation of formula (4) is as follows, "A" being the areas and "V" the volume of the drum or reel—

$$A_D — As = \frac{\pi D^2}{4} — \frac{\pi S^2}{4} = \frac{\pi\ (D^2 — S^2)}{4}$$

$$V = (A_D — As)\ L = \frac{\pi\ (D^2 — S^2)\ L}{4}$$

for a bar 1″ square x 1″ long, the volume will be 1 cubic inch and the length of such a bar in a volume "V", will be

$$C_2 = \frac{\pi/4\ (D^2 — S^2)\ L}{d^2}$$

and the length "C" in feet, will be 1/12 of this, or

$$C = \frac{1}{12}\left[\frac{\pi\ (D^2 — S^2)\ L}{4d^2}\right]$$

$$= \frac{\pi\ (D^2 — S^2)\ L}{48d^2}$$

$$C = \frac{.0655\ (D^2 — S^2)\ L}{d^2}$$

✦ ✦ ✦

THE assumption made in the laying up of the rope on the drum per your sketch and article, leading to the constant 0.3, is incorrect; consider it as follows. The first layer on the drum winds left to right, the second layer must wind from right to left; however, the second layer does "track" or fit into the "valley" between adjacent coils of the first layer but at one section of the perimeter of the drum, there must be a "cross-over" as the first layer is a left-hand spiral and the second layer is nominally a right-hand spiral; consequently, at the "cross-over" section, rope winds on top of rope and not in the "valley" underneath; the same condition occurs for each layer of rope on the rope, so that "h" is greater for a given number of layers of rope than assumed.

✦ ✦ ✦

THE assumption made in the derivation of (4) are not strictly correct either but years of experience with (3) and (4) have proven the results quite reliable. However, in making such calculations it is well to remember that wire ropes are generally oversize, a 1″ rope will be at least $1\frac{1}{32}$″ diameter; the value for "h" should be taken as a multiple of the rope diameter "d"; while this is of not much moment with small ropes, with large ropes, say $1\frac{1}{4}$″ diameter and larger, some inconvenience and expense may be avoided if this latter is kept in mind.

✦ ✦ ✦

IN formulae (3) and (4), the nominal diameter "d" of the rope may be used instead of the actual diameter, providing the rope is not too much oversize; it has been found that this compensates for the approximation made in the derivation of these formulae.

✦ ✦ ✦

IN this connection, if formula (2) is considered for a 1″ rope and a value of $1\frac{1}{32}$″ used for "d", the value of the constant .283 reduces to .266, which is quite close to the constant .262 in (3) and (4); the writer knows Mr. Voigtlander quite well and respects his mathematical knowledge but, nevertheless, prefers the usage of formulae (3) and (4).

✦ ✦ ✦

BY formula (3) or (4), the amount of rope on the drum per your example, will be 15,720 ft. and by formula (2), it is 16,980 ft. and by using the constant of .266 instead of .283 in the latter, it becomes 15,960 ft. instead of the 18,000 ft. as given in your article.

✦ ✦ ✦

THE same formulae may be utilized for determining the length of rope, etc., in a coil.

✦ ✦ ✦

MR. Donald E. Dickey, of the Broderick & Bascom Rope Co., St. Louis, Mo., advises: "We notice in your January, 1935 issue on page 42, that someone has presented a formula for calculating drum capacities.

✦ ✦ ✦

IN checking it, we note that it is practically the same as one which has been published in our catalog for a number of years. The one difference lies in the fact that the formula published in your magazine uses a multiplier of .3 and leaves the notation d^2 in the denominator, while we take the entire term $\frac{\pi}{12\ d^2}$ and reduce it to multipliers for different sizes of rope. Actually, the only difference between our formula and the one

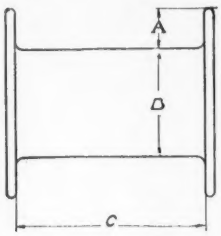
published is that our value of $\pi/12$ is .2618 instead of .3.

It is possible that the .04 difference will take care of the drop of rope into the "valleys" but we doubt if any rope will spool that accurately onto the drum."

✦ ✦ ✦

Drum Capacities

A FORMULA for computing the rope capacity in feet of any size drum.



Rule

Add the depth of flange (A) to diameter of drum (B).

Multiply the sum by the depth of the flange (A).

Multiply the result by the width of the drum between the flanges (C).

Multiply product by figure in column opposite rope size.

Example:

$(A + B) \times A \times C \times$ Multiplier

Multipliers

Rope Size	
1/4 inch	4.16
3/8 inch	1.86
7/16 inch	1.37
1/2 inch	1.05
9/16 inch	.828
5/8 inch	.672
3/4 inch	.465
7/8 inch	.342
1 inch	.262
1 1/8 inch	.207
1 1/4 inch	.167
1 3/8 inch	.138
1 1/2 inch	.116
1 5/8 inch	.099
1 3/4 inch	.085
1 7/8 inch	.074
2 inch	.066
2 1/8 inch	.058
2 1/4 inch	.052
2 3/8 inch	.046
2 1/2 inch	.042

Simplified Practice

Dental Hypodermic Needles

A GENERAL conference of representatives of manufacturers, distributors and users of dental hypodermic needles drafted, on June 17, 1929, a simplified practice recommendation for dental hypodermic needles, which was revised in 1934. The industry has accepted, and approved for promulgation by the United States Department of Commerce, through the National Bureau of Standards, the following revised simplified list of stock sizes of dental hypodermic needles:

TABLE 1.—Hexagonal hub; standard thread, curved and straight

Birmingham (or stubs iron) wire gage	Length (Inch)	Material
25	3/16, 1/4, 5/16, 1/2	Carbon and stainless steel or 18 by 8 steels, such as Alleghany.
26	1/4	

TABLE 2.—American Luer standard slip hub, curved and straight

Birmingham (or stubs iron) wire gage	Length (Inch)	Material
25	1/4, 1/2	Carbon and stainless steel.

TABLE 3.—Conductive anesthesia hexagonal hub, standard thread; and American Luer standard slip hub, straight

Birmingham (or stubs iron) wire gage	Length (Inches)	Material
23	1, 1 1/4, 1 5/8	Carbon and stainless steel, iridium platinum and other platinum alloys.
25	1, 1 5/8	

TABLE 4.—Cartridge type needles

Birmingham (or stubs iron) wire gage	Length[1] (Inches)	Material
25 and 23	1, 1 1/4, 1 7/8	Iridium platinum and other platinum alloys, chromium plated or stainless steel.

[1]Measured from ball to tip.

TABLE 5.—Schimmel and other interchangeable needles

Birmingham (or stubs iron) wire gage	Length (Inches)	Material
25 and 23	1, 1 5/8	Carbon steel, iridium platinum, and other platinum alloys, chromium plated or stainless steel.

This recommendation, subject to regular revision by a standing committee of the industry is effective beginning October 1, 1934.

WIRE MILL FOR SALE
EQUIPPED TO DRAW FINE STEEL WIRE
in sizes from No. 15 to 36. All Finishes.
Located in East—Accessible to all Markets—
Low price—Satisfactory Terms.
FOR INFORMATION ADDRESS
BOX 200—C/O WIRE AND WIRE PRODUCTS
17 East 42nd St., New York, N. Y.

Outstanding Personalities of the Wire Industry

CLIFFORD F. HOOD
Vice-President
American Steel & Wire Company

CLIFFORD F. HOOD, manager of the Worcester, Mass., district for the American Steel & Wire Co., has been appointed vice president in charge of operations of the company, with headquarters in Cleveland, succeeding J. L. Perry, who has been transferred to Birmingham, Ala. Mr. Hood is a graduate of the University of Illinois and from 1915 to 1917 was associated with the Packard Electric Co. He then became an operating clerk at the South works of Steel & Wire at Worcester, leaving shortly thereafter to join the army during the war. Returning in 1919, he was named foreman of the cable works at Worcester, remaining in this capacity until 1925 when he was made assistant superintendent of the South works. From 1928 to 1932 he was assistant manager of the Worcester district, and since 1933 has been manager there.

C. I. COLLINS
Manager, Worcester District
American Steel & Wire Company

C. I. COLLINS, superintendent of the Cuyahoga works of Steel & Wire at Cleveland, will go to Worcester as manager of that district. Born in Asheville, N. C., he attended Georgia School of Technology and graduated in mechanical engineering. From 1912 to 1915 he was associated with the Atlanta Steel Co., Atlanta, Ga., and in 1915 became factory superintendent for the United States Cartridge Co., continuing there until 1917. During the war he was active in the army air service and in 1919 joined the sales force of the Hyatt Roller Bearing Co. In 1923 he became assistant general manager for the Morris & Bailey division of Steel & Wire, later becoming general manager. In 1930 he was transferred to the vice president's office in Cleveland and in 1934 was made superintendent of the Cuyahoga works.

B. H. GEDGE
Superintendent, Cuyahoga Works
American Steel & Wire Company

B. H. GEDGE, assistant superintendent of the Cuyahoga works, will succeed Mr. Collins as superintendent. He is a graduate in electrical engineering from Purdue university, Lafayette, Ind., and first was employed by American Steel & Wire at the Cuyahoga works in 1911 as electrician. In the period of the next eight years he held various positions in this plant and was placed in charge of rolling operations in 1920. He continued in this capacity until 1924 when he was promoted to superintendent of hot mills. After directing operations in this department for about a year, he was appointed to the post of assistant superintendent of the Cuyahoga works. For approximately the past ten years he has held this position and now, following Mr. Collins' transfer to Worcester, succeeds to the superintendency.

Percy R. Clark

PERCY R. CLARK, Managing Director of The Anglia Company, Ploesti, Roumania, was appointed chairman of the Roumanian Section of the Institution of Petroleum Technologists (London) at the last general meeting of that organization.

Andrew J. Fletcher Thesis Wins Westinghouse Job

A COLLEGE thesis based on an economic study of incandescent lamps proved to be the deciding factor in the selection of Aubrey J. Fletcher to fill the position of an electrical engineer in the commercial engineering department of the Westinghouse Lamp Co. at Bloomfield, N. J. The subject of the thesis was "The Most Economic Efficiency for Mazda Lamps." Written for a degree at the University of Washington, it was sent to the Westinghouse Lamp Co., for criticism by their engineers. It won immediate recognition for Mr. Fletcher.

Outstanding Personalities of the Wire Industry

W. C. BUCHANAN
President, Keystone Steel & Wire Co., Peoria, Illinois

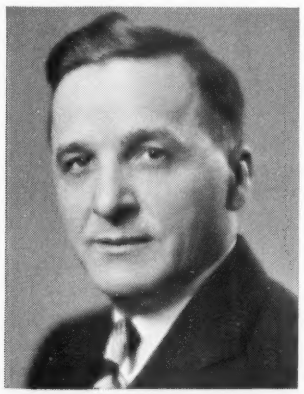
AT the recent meeting of the directors of the Keystone Steel & Wire Co., Peoria, Illinois, W. C. Buchanan, general manager of the company, was elected president.

✦ ✦ ✦

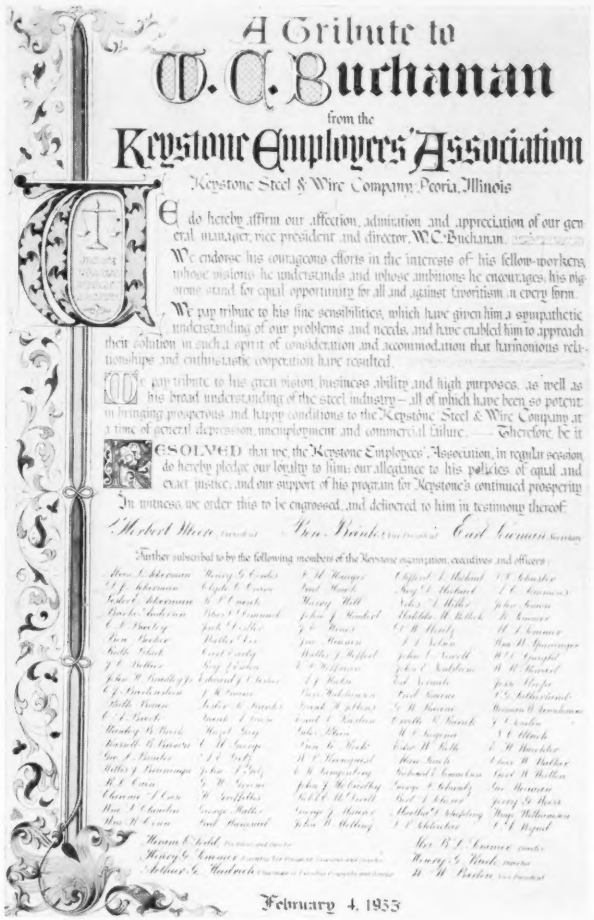
AT the annual Keystone Steel & Wire Company employes' party held at the Shrine temple, Peoria, Ill. recently and attended by over 3,000 employes and families of workers, the festivities were marked by the presentation of a plaque as a token of esteem by the Keystone Employes' Association to W. C. Buchanan, then general manager.

✦ ✦ ✦

THE presentation was made by Herbert Moore, President of the employes' association who with appropriate words unveiled the plaque on which had been engrossed a tribute expressing the appreciation, admiration and loyalty of the employes' organization. In addition to the names of officers of the association, the plaque also bore the names of more than 100 executives, officers and directors of the Keystone company.



W. C. BUCHANAN
President
The Keystone Steel & Wire Co.



A Tribute to
W. C. Buchanan
from the
Keystone Employees' Association
Keystone Steel & Wire Company, Peoria, Illinois

We do hereby affirm our affection, admiration and appreciation of our general manager, vice president and director, W. C. Buchanan.

We endorse his courageous efforts in the interests of his fellow-workers, whose interests he understands and whose ambitions he encourages, his rigorous stand for equal opportunity for all and against favoritism in every form.

We pay tribute to his fine sensibilities, which have given him a sympathetic understanding of our problems and needs, and have enabled him to approach their solution in such a spirit of consideration and accommodation that harmonious relationships and enthusiastic cooperation have resulted.

We pay tribute to his great vision, business ability and high purposes, as well as his broad understanding of the steel industry—all of which have been so potent in bringing prosperous and happy conditions to the Keystone Steel & Wire Company at a time of general depression, unemployment and commercial failure. — Therefore, be it

RESOLVED that we, the Keystone Employees' Association, in regular session do hereby pledge our loyalty to him; our allegiance to his policies of equal and exact justice, and our support of his program for Keystone's continued prosperity.

In witness we order this to be engrossed, and delivered to him in testimony thereof.

Further subscribed to by the following members of the Keystone organization, executives and officers:

February 4, 1935

MR. Buchanan came to the company about five years ago and was made general manager within a short time. Employes, according to leaders of their association, extend him the credit for Keystone's condition during a time of general unemployment and commercial failure.

John S. Stanier

JOHN S. STANIER, newly-appointed superintendent of the new cold-rolled strip mill of the Youngstown Sheet & Tube Co., Youngstown, O., is a graduate of Lehigh University, 1923, his studies having been interrupted by war service. From 1923 to 1928 he was connected with the former West Penn Steel Co., Brackenridge, Pa. He was special mill representative of the Newton Steel Co., and later was vice president in charge of operations. In 1933 he went with the Sheet & Tube Company as superintendent of sheet mills, Brier Hill division, which he leaves for his new post. His 22 years' experience has largely been in the field of high grade sheet manufacture.

R. W. Frawley
Sales Promotion Manager Gulf States Steel Co.

R. W. FRAWLEY, for 30 years a member of the sales staff of the Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., has been named new sales promotion manager for the Gulf States Steel Co., Birmingham, Ala.

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in Jan. 1935 and Jan. 1934
(In gross tons)

	Jan. 1935	Dec. 1934	Jan. 1934
Wire rods	3,279	460	7,011
Hoops, bands and strip steel	2,772	3,528	2,901
Plain black or galvanized iron or steel wire	3,220	2,821	3,518
Barbed wire and woven wire fencing	2,724	2,763	2,335
Woven wire screen cloth	100	66	36
Wire rope	231	149	284
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	365	338	470
Wire nails	783	1,017	866
Tacks	36	29	30
Other nails, including staples	239	259	213
Bolts, machine screws, nuts, rivets and washers	438	533	424
Total, these 11 classifications	14,187	11,963	18,088

Imports of Iron and Steel Wire Products Into The United States
(In gross tons)

Concrete reinforcement bars	109	37	46
Hollow bars and drill steel	50	59	61
Merchant steel bars	2,210	1,443	1,033
Wire rods	775	962	747
Barbed wire	1,684	332	1,549
Round iron and steel wire	415	211	258
Telephone and telegraph wire	....	3	1
Flat wire and strip steel	112	180	49
Wire rope and strand	193	80	145
Other wire	146	52	2
Hoops and bands	2,207	1,033	823
Nails, tacks and staples	993	435	605
Bolts, nuts and rivets	36	8	28
Total, these 13 classifications	8,930	4,835	5,347

January Exports Decline by 7.1 Percent—Imports Advance

EXPORTS of iron and steel products from the United States during January amounted to 262,740 gross tons, dropping 7.1 percent under the total for the previous month, but were considerably ahead of shipments made during the corresponding month of 1934 (by 32.1 percent).

✦ ✦ ✦

IRON and steel products were imported to the extent of 22,784 tons in January a rise of 15.6 percent over the December taking and approximated the 22,653-ton import trade of January 1934. The month's trade was marked by substantial gains in receipts of plain structural shapes, 'other pipe', hoops and bands, also by lower tonnages of pig iron and scrap.

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DECREASES were recorded in 38 export classifications when compared with the December trade, while gains occurred in 23. The most pronounced drop occurred in total scrap shipments—aggregating 186,112 tons—which fell 10,249 under December figures, while heavy rails declined substantially by 6,133 tons, followed by tin plate, 2,363 tons. Shipments of fabricated structural shapes suffered a loss of 1,178 tons, with seamless casing and oil-line pipe lower by 1,059 tons, and light rails, by 969 tons. The most conspicuous gain was in wire rod shipments, 2,819 tons, closely followed by black steel sheets, 2,695 tons, other increases of moment occurring in ingots, blooms, billets, slabs, and sheet bars, 1,442 tons, welded casing and oil-line pipe, 1,141 tons, welded galvanized steel pipe, 809 tons, frames, sashes and sheet piling, 433 tons, plain wire, 387 tons, and iron castings, 337 tons.

✦ ✦ ✦

SCRAP iron and steel maintained its role of the leading iron and steel product exported from the United States on a tonnage basis, although the January shipments of 179,630 tons were 16,731 tons below those made during December, which included all scrap classifications. The January total was distributed chiefly among Japan, 107,604 tons; the United Kingdom, 21,555 tons; Italy, 20,425 tons; Poland and Danzig, 9,663 tons; Kwantung, 4,566 tons, Canada, 3,921 tons; Mexico, 2,975 tons; and Egypt, 1,790 tons. Tin plate and taggers' tin was the next product of the month, finding its chief outlets in Japan, 3,873 tons; the Soviet Union, 1,603 tons; Cuba, 1,541 tons; China, 1,406 tons; the Philippine Islands, 1,389 tons; and Brazil, 1,137 tons. Black steel sheets—showing a substantial rise of 2,695 tons—was the third major product in the month's trade, going to numerous markets chief among which was the Soviet Union, 3,494 tons; Canada, 3,233 tons; Mexico, 1,330 tons; Brazil, 1,016 tons; and Japan, 714 tons. Galvanized steel sheets was next in importance and were purchased chiefly by the Philippine Islands, 964 tons; Colombia, 875 tons; Cuba, 555 tons; Brazil, 491 tons; the Union of South Africa, 468 tons; and Mexico, 328 tons. Steel bars followed and went principally to Canada, 2,554 tons; Panama, 580 tons, the Philippine Islands, 327 tons; Colombia, 236 tons; and Japan, 197 tons. Tin plate scrap totaling 4,209 tons was the sixth product of importance and was absorbed by Japan, 3,680 tons; China, 295 tons; and Canada, 234 tons.

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January Imports Gain

IMPORTS of iron and steel products into the United States during January aggregated 22,784 gross tons, rising 15.6 percent over the December trade. Increases occurred in 18 individual classifications, with losses in 13, while in 3 products there was no trade in either month. A new class—"malleable iron pipe fittings" has been incorporated into the tabulations of import statistics for the coming year, while the hoop and band classification has been divided as follows: "cotton ties", and "other hoops and bands". Increased receipts of structural shapes, 1909 tons, 'other pipe', 1,379 tons, and barbed wire, 1,352 tons, were outstanding in the January trade,

(*Please turn to page 158*)

A Review of Recent Wire Patents

No. 1,989,660, COVERING MACHINE FOR ELECTRICAL CONDUCTORS AND THE LIKE, Patented February 5, 1935 by Otto Ballert and Erhard Wendt, Berlin, Germany.

Ths wire covering machine is claimed by the inventors as so constructed as to decrease noise and the usual difficulties of lubricating and packing.

✦ ✦ ✦

No. 1,989,914, CABLE, Patented February 5, 1935 by Philip H. Chase, Bala-Cynwyd, Pa.

About the wire conductor of this cable is a sheath wth a series of closed hollow tape-like, gas-filled containers within the sheath, the containers being linked to form one or more chains.

✦ ✦ ✦

No. 1,990,071, METHOD OF MAKING WIRE ROPE, Patented February 5, 1935 by Richard Duane Green and William E. Craig, Trenton, N. J., assignors to John A. Roebling's Sons Company, Trenton, N. J., a corporation of New Jersey.

The method consists in twisting some or all of the rope wires on their axes, then transferring the twisted wires to the laying up machine while maintaining the twist and finally laying up the rope wires helically to form the rope.

✦ ✦ ✦

No. 1,990,082, WIRE ROPE MAKING MACHINE, Patented February 5, 1935 by Archibald J. Morgan, Trenton, N. J., assignor to John A. Roebling's Sons Company, Trenton, N. J., a corporation of New Jersey.

The machine is adopted for making wire rope in which the individual wires or strands are laid up helically about a core and then compressed by a squeezer in closing. The inventor employs a die made in the form of a continuous ring, through which the wire passes before reaching the squeezer, the die closing the wires on the coil. The machine also includes a device for varying the angle at which the wires or strands pass from the wire guides to the die by adjusting the die axially towards and from the guides.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

No. 1,990,337, METHOD OF APPLYING A FIBROUS COATING TO A FILAMENT OR WIRE, Patented February 5, 1935 by Edward H. Lewis, Bridgeport, Conn., and Benjamin W. Luttenberger, Manheim, Pa.; said Luttenberger assignor to Raybestos-Manhattan, Inc., Passaic, N. J., a corporation of N. J.

Longitudinal movement of the wire conductor is effected while the same is held against rotation. As a result stationary supporting reels may be used.

✦ ✦ ✦

No. 1,991,024, METHOD OF PRODUCING METALLIC SCOURING PADS, Patented February 12, 1935 by Daniel J. Mayer, Belleville, N. J., assignor to Metal Textile Corporation, West Orange, N. J., a corporation of Delaware.

It is stated that the method produces a spirally convolved metallic wire interwoven upon itself in a criss-crossed relation so the strands will interlock to prevent raveling of the pads.

✦ ✦ ✦

No. 1,991,106, SPRING MATTRESS, Patented February 12, 1935 by William Lewis, Utica, N. Y.

An intermediate resilient deck is provided in about the same plane as the marginal rails of the main supporting frame of the mattress structure, so as to obtain gradually increasing resistence of the spring.

✦ ✦ ✦

No. 1,991,485, MACHINE FOR POLISHING WIRE STOCK, Patented February 19, 1935 by Joseph E. Batie, Detroit, Mich., assignor to Kelsey-Hayes Wheel Corporation, Detroit, Mich., a corporation of New York.

The machine is adapted for polishing wire stock prior to introducing the stock to the forming apparatus and includes a device for advancing the stock along a predetermined path, with abrasive wheels for polishing the stock during its travel along the path, all sides of the wire stock being polished as the latter is advanced.

✦ ✦ ✦

No. 1,991,606, METHOD OF MAKING THERMIONIC TUBE GRIDS, Patented February 19, 1935 by William W. Eitel and Jack McCullough, San Bruno, Calif., assignors to Heintz & Kaufman, Ltd., San Francisco, Calif., a corporation of Nevada.

This method of making a vacuum tube grid comprises assembling a number of hair-pin shaped wires in the form of a cylinder, the straight runs of the hairpins being parallel and equally spaced, and then welding the open ends of the hairpins into a ring support, after which the bends are welded together. After the welding is completed, pressure is applied between the support and the bends to stretch the straight runs.

✦ ✦ ✦

No. 1,992,206, WIRE COATING APPARATUS, Patented February 26, 1935 by John P. Gerber, Muskegon, Mich., assignor to The Electric Auto-Lite Company, Toledo, Ohio, a corporation of Ohio.

More specifically, the invention relates to a wire enameling oven, an electrically energized heating element being provided and having a number of serially connected portions. The effective length of these portions may be varied so that the heated length may be adjusted as desired. The oven is stated to be applicable where one or more enameled coats is applied to a wire and each coat separately heated in turn.

✦ ✦ ✦

No. 1,992,286, MACHINE FOR MAKING BALE TIES, Patented February 26, 1935 by Albert F. Bradley, Sterling, Ill., assignor to Northwestern Barb Wire Company, Sterling, Ill., a corporation of Illinois.

Specifically, the machine is adapted for forming bayonet loops upon one end of the wire ties and heads upon the other end.

New S. A. E. Steels Specifications Chart

A NEW S. A. E. steels specifications chart has been reprinted by the Republic Steel Corporation from the most recent revision of the list of standard S. A. E. alloy and carbon steels. The chart is published with the permission of the Society of Automotive Engineers.

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COPIES can be obtained from the Republic Steel Corporation advertising department, Massillon, Ohio.

Robert Goss Wells Dies; Canada Steel Executive

ROBERT GOSS WELLS, vice-president of the Steel Company of Canada, former resident engineer of the Dominion Iron and Steel Company, Sydney, N. S. is dead.

✦ ✦ ✦

HE was born in Utica, N. Y. In 1913 he became assistant works manager of the steel company, and following the death of Robert Hobson in 1926, he was made vice-president, and continued as works manager until a few months ago.

MR. WELLS had held important engineering positions in Canada, the United States, Russia and India. Among his positions in the United States was engineer of construction of the Otto-Hoffman Coke Company in New York from 1901 to 1906.

✦ ✦ ✦

Reels And Spools Standardization

Reprints of the report of this committee as published in the November, 1934, issue of WIRE & WIRE PRODUCTS, outlining the proposed new standards for reels and spools for insulated wire and cable can be obtained for 25c a copy.

Spot Welding

(*Continued from page 144*)

pieces to be welded, as shown in Figure 3. This projection drastically reduces the area of contact between the metal parts and causes a correspondingly great increase in current density and heating power at the exact spot where it is most desired. Moreover, when the projection softens and welding occurs, the electrode pressure, by flattening the projection, enlarges the contact area and thus reduces the current density and prevents overheating.

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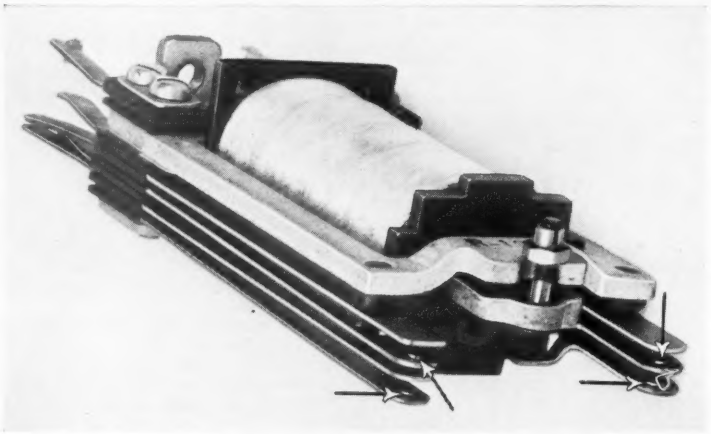
ONE disadvantage of any form of welding is the possible harmful effect of the intense local heating necessary. Although in spot welds this effect is greatly reduced, it cannot be entirely eliminated. Thus zinc is recrystallized and made brittle, iron may be slightly oxidized, zinc may be partly distilled out of brass, and duralumin and tool steels may be given an undesirable heat treatment. The area of local heating and undesired effects can be reduced considerably, without reducing the actual size of the spot weld, by using a high welding current for an extremely short time and by making welds under the surface of a cooling and protecting liquid such as water.

WITHIN the telephone industry spot welding has been of increasing importance. Among the many uses which have resulted in considerable economies are the formation of vacuum tube assemblies, the fastening of precious metal contacts to relay springs, and the manufacture of sheet metal cases for various purposes.



An extensive application of spot welding is to fasten the precious metal contacts to the springs of relays.

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'Round the World With the Wire Industry

German Notes

THE German wire rod cartel has announced that the AVI returns for wire rods will be advanced from 35 to 38 Marks per ton for February whereas all other returns have been left unaltered.

✦ ✦ ✦

THE cartel also says that business remains satisfactory on the domestic markets. The turnover for most of the wire products shows a further increase. The export situation is unaltered. A number of fresh contracts have been booked from the Far East, but the keen American and Japanese competition has forced the cartel to reduce prices again. Reports that an agreement with the American industry has been signed which concerns the competition on the Central American markets, have not been confirmed. Export business in hexagonal netting is unsatisfactory; turnover has declined in January compared with December. The barter business is the only exception.

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Wood Screw Cartel Sales

THE wood screw cartel reports that turnover increased in 1934 by 45% compared with 1933. The export turnovers increased by 24%. It is of some interest that German wood screw exports have been resumed to the United States, though in previous years no German wood screws of any kind had been shipped to the United States. This was due to the agreement with the American Wood Screw Corporation. It is not yet confirmed whether the resumption of wood screw export on a moderate scale actually means that this agreement has been given up, but it is possible that this might be the case. The German wood screw cartel refuses to comment on this.

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Agreement Pending Between Austrian and Czecho Slovakian Wire Industry

BETWEEN the Austrian and Czecho Slovakian wire industry negotiations are pending at present which concern a non-competitive agreement. So far these negotiations have not yet been brought to successful conclusion but it is improbable that anything can actually be arranged as the differences are too great.

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Polish Competition Continues in Central Europe

THE Polish-German barter agreement also concerns wire. The total German quantity to be shipped to Poland will be approximately 6000 tons in 1935, most of this quantity being special wire products. In the meantime Polish competition on the wire rod market is still continuing. The quantity of wire rods sold by the Polish industry is not considerable, but heavy enough to disturb the market. Most of the Polish wire rods are sold through German merchants.

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Leipzig Fair Exhibits Wire Machines

AT the Leipzig Spring Fair more than 180 different wire machines will be exhibited to the international industry, which is approximately 40% more than last year.

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Wire Mesh Produced Thinner Than 200 Mesh

WIRE mesh has now been produced for the first time commercially thinner than 200 mesh. For certain industry orders have been placed for stainless steel wire mesh at a quantity of 240 mehs per square inch. Stainless steel wire has been reduced in price 10%.

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Chile Self-Sufficient in Washers

CHILE now produces washers in sufficient quantities to meet domestic demands and for this reason little opportunity is afforded for the sale of washers of foreign manufacture in that country, advises Consul General Edward A. Dow, Santiago. Washers used in Chile correspond in size and measure to those in current use in the United States.

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Honduran Representative Wants American Barbed Wire, Staples and Wire Nails

THE Consul at San Pedro Sula, Honduras, reports the interest of a local representative in taking over an American line of barbed wire, staples and wire nails. Any firm interested in pursuing this matter further can do so by communicating with the Bureau direct or with its district or cooperative offices and referring to trade opportunity No. 8410.

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Mexican Telephone Systems Not to be Changed

IN connection with a recent report published in WIRE & WIRE PRODUCTS that the telephone systems of Mexico are to be modernized, we are advised by Thomas D. Bowman, American Consul General, Mexico City, as follows: "A representative of this office called on both the telephone companies operating here, who advised that the report received by you was nothing but a rumor. It was stated, as is true, that the present automatic system in Mexico is of the most modern type, such as is installed in the largest cities in the world. "Modernization" is therefore out of the question."

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Wire Representation in Cuba

THE American consul at Habana states that a local firm of representatives is interested in obtaining an American line of bright, plain, galvanized, and barbed wire, and also for wire netting, staples and wire nails. Any firm interested in this Trade Opportunity, No. 8589, may obtain further particulars from the Bureau direct or through its District or Cooperative offices.

Exports and Imports

(*Continued from page 154*)

while consequential gains were registered in hoops and bands (including cotton ties), 1,254 tons. The most prominent decrease was recorded in scrap receipts, 2,074 tons, followed by pig iron, 1,609 tons, ferro-manganese and spiegeleisen, 904 tons, steel ingots, blooms, etc., 213 tons, and wire rods, 187 tons.

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STRUCTURAL shapes constituted the most important item in the month's import trade, the 3,569 tons received coming from Belgium, 2,478 tons, Germany 767 tons, and France, 324 tons, while the 2,630 tons of ferro-manganese and spiegeleisen received made up the second major product. This total was supplied chiefly by Norway, 1,426 tons, Canada, 683 tons, the United Kingdom, 237 tons, and Italy, 100 tons. The 2,415 tons of scrap ranked next, and was furnished entirely by Canada. Merchant and other steel bars were received to the extent of 2,210 tons, coming chiefly from Belgium, 1,611 tons; France, 316 tons; and Sweden, 223 tons; while the fifth product of the month was 'other hoops and bands' totaling 2,207 tons, supplied principally by Belgium, 1,615 tons; France, 486 tons; and Germany 96 tons. Barbed wire imports amounted to 1,684 tons with Germany in the role of the leading supplier, 1,283 tons, followed by Belgium with 285 tons, and the Netherlands 116 tons. 'Other pipe' was the seventh product in the month's trade totaling 1,669 tons and coming mostly from Germany, 1,530 tons, with Sweden supplying 129 tons.

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AGAIN was registered in **card clothing** imports when the January total—all from the United Kingdom—at 16,113 square feet valued at $22,090 increased by 7,902 square feet and $9,340 over the trade during the previous month.

THERE was a further decline of 5,266 square feet in receipts of **wire cloth and screening** when January takings amounted to only 40,254 square feet. This amount was supplied by Germany, 29,159 square feet, Canada, 5,382 square feet, the Netherlands, 3,114 square feet, and France, 2,599 square feet.

✦ ✦ ✦

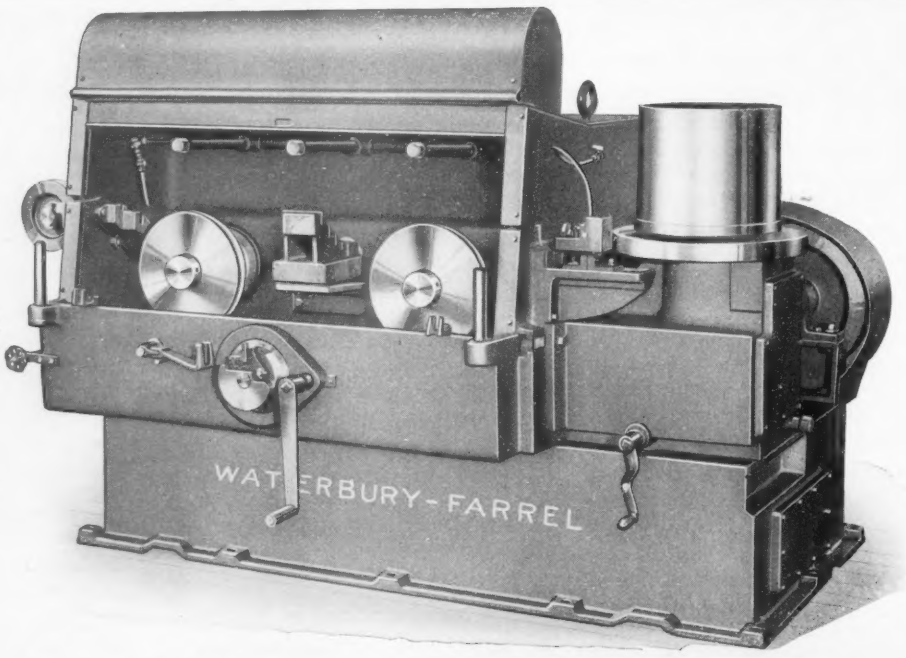
IMPORTS of **wire fencing and netting** galvanized before weaving amounted to 1,127,825 square feet, registering a sharp rise of 988,324 square feet over the December trade, and originated in Belgium, 716,825 square feet, and the Netherlands, 411,000 square feet. Another decline occurred in receipts of the galvanized after weaving, only 159,000 square feet being received during January, a drop of 65,500 square feet under the December trade. Of this total 150,000 square feet were supplied by Belgium, and 9,000 square feet by the Netherlands.

✦ ✦ ✦

A VERY sharp decline was recorded in receipts of **four-**

No. 3-7 DIE
FOR BRASS

CLEANER
WIRE AT
LOWER COSTS
AND
BETTER
QUALITY AT
HIGHER
SPEEDS



Waterbury Farrel Foundry and Machine Company

Waterbury, Connecticut

OFFICES
CLEVELAND CHICAGO PHILADELPHIA

drinier and other paper-making wires when the total of 7,668 square feet fell off by 35,053 square feet from the December total. **Wire heddles** were imported to the extent of 2,308,000 pieces, a gain of 196,000 pieces, and came from France, 1,440,000 pieces, Germany, 851,000 pieces, and the United Kingdom, 17,000 pieces.

✦ ✦ ✦

James F. Leahy

JAMES F. LEAHY, general superintendent of the Buffalo (N. Y.) plant of the Farrel-Birmingham Company, Inc., died at his home in Kenmore, N. Y., on Wednesday, March 6, 1935, after a month's illness.

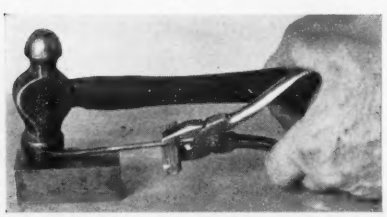
✦ ✦ ✦

MR. LEAHY was born in Torrington, Conn., October 23, 1870, and had been in the employ of the Farrel company since December 2, 1901. He had served as machine shop foreman at the Ansonia plant before being transferred to the superintendency at Buffalo 12 years ago. He was a skilled mechanic and an expert in gear cutting. He was held in high esteem by the concern with which he had been connected for so many years, both for his mechanical skill and his ability as an executive.

✦ ✦ ✦

Kink for Gripping Wire Tight in Pliers

ORDINARY pliers leave much to be desired when they are used as tongs to hold heated wire and drill rod as it is being hammered out. This is because the jaws are not parallel and the wire is only gripped at the back of the jaws thus allowing it to swing from side to side as it is hammered.



A VERY simple way to stop this and enable a pair of pliers to hold wire with a vice-like grip is shown in the photograph. Take a piece of soft wood, lay it across one jaw, place the wire on top and grip the whole thing together. The wire sinks in the wood and holds perfectly.

✦ ✦ ✦

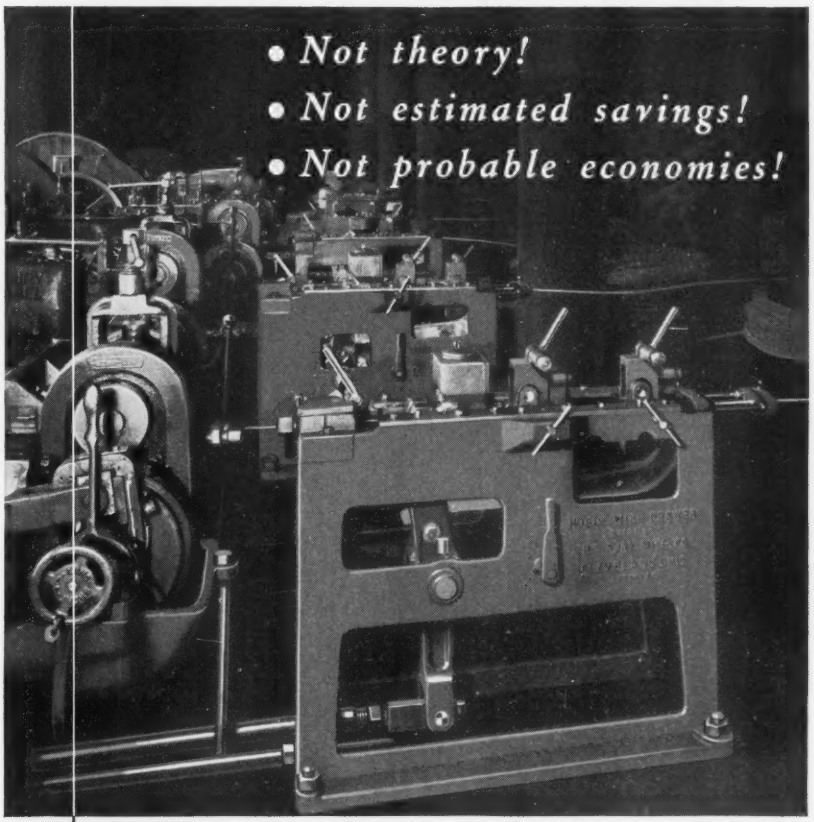
Cox Steel & Wire Company, Inc.

COX Steel & Wire Company, Inc., has been organized at Dallas, Texas, wiht capital stock of $50,000 by W. T. Cox, E. F. Langham and H. W. Davis, to deal in iron and steel.

✦ ✦ ✦

Circle Wire & Cable Corporation

CIRCLE Wire & Cable Corporation, has been organized at Brooklyn, N. Y., with capital of $250,000 to manufacture electrical wire products, cables, etc. Harry Sena, 225 Broadway, New York City, represents the company.



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SEND FOR BULLETIN 110 It's Yours for the Asking

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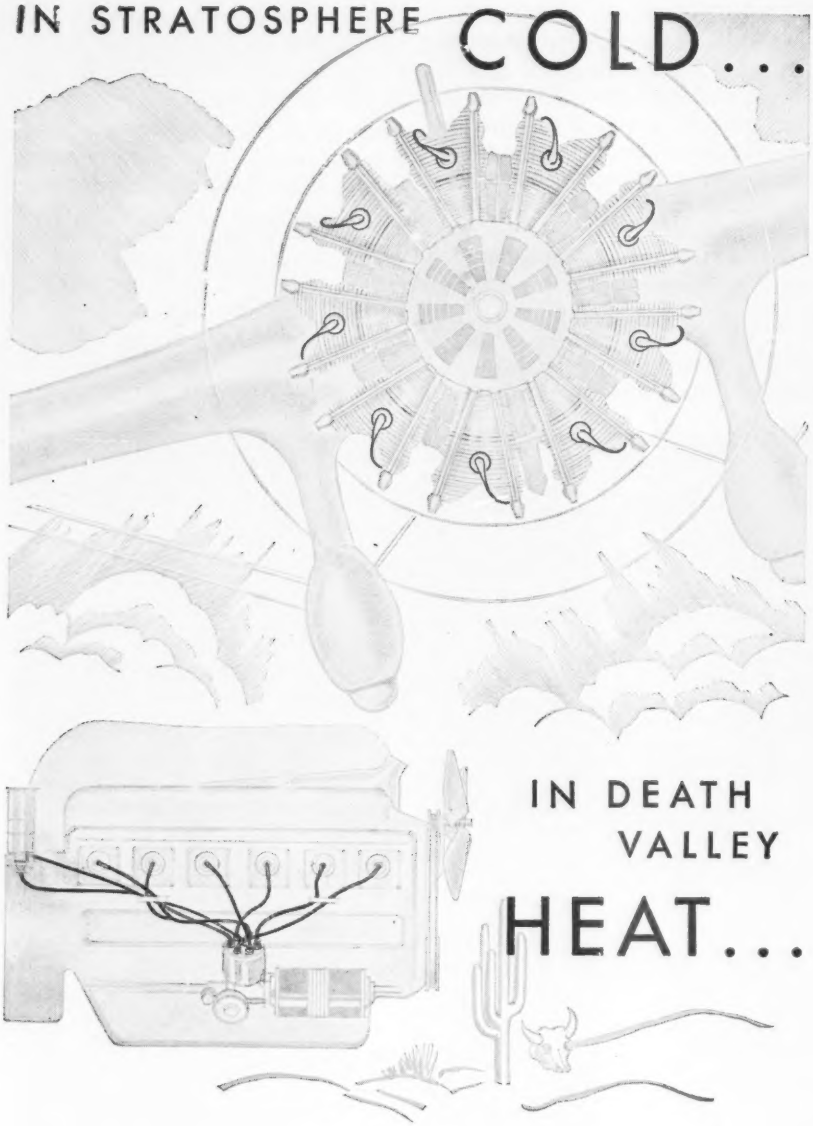

IN DEATH VALLEY HEAT . . .

Here's an insulated cable lacquer that really stands up

In blistering, searing heat and sub-zero cold — in flame tests, oil tests, kerosene tests; in every conceivable test A & W's remarkable cable lacquer has demonstrated qualities that hitherto have been unobtainable.

And no wonder — for it's "tailor-made" by A & W for this particular purpose. Both formula and application have been carefully and repeatedly checked under actual manufacturing conditions in our own cable lacquering tower.

You are invited to inquire about this and other A & W "Tailor-made" lacquers for wire and cable of every sort and for every purpose.

AULT & WIBORG CORPORATION
NEW YORK, N.Y. CINCINNATI, OHIO
MIC ET UBIQUE

Lubrication as Affected by Physical Properties of Lubricants

(*Continued from page 146*)

viscosity and thickness of the film of lubricant rather than on the chemical nature of the lubricant or surfaces. Points of asperity at which conditions of boundary lubrication do exist probably account for not obtaining lower frictional coefficients. The lack of exact parallelism between the results for copper and stainless steel is believed to be due mainly to differences in adhesion of the lubricant for the metal, to the influence of the temperature attained at the interface, and to specific effects at points of asperity.

✦ ✦ ✦

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(2) Lewis, K. B., Wire & Wire Products, 8, 197, 234, 266, 331 (1933).
(3) National Metals Handbook, 1933.
(4) Williams, R. C., J. Phys. Chem., 36, 3108 (1932).

Presented before the Division of Colloid Chemistry at the 88th Meeting of the American Chemical Society, Cleveland, Ohio, September, 1934.

✦ ✦ ✦

The Embrittlement of Low Carbon Steel

(*Continued from page 147*)

steel AS 5 showing remarkable toughness at the higher temperatures. This recovery becomes less apparent as the carbon content increases, and steel AS 8 remains extremely brittle after quenching at all temperatures above the A_1 change point. In all cases test pieces were tested within 5 hours of quenching. A duplicate quenched test piece was set aside for 50 days and then tested by impact. Maximum brittleness is found to occur in the range from 675 deg. C. to 775 deg. C., and is very pronounced in steel AS 5. Little embrittlement due to ageing, however, is evident in steels containing 0.29 per cent. of carbon and upwards. On the other hand, quenching a 0.12 per cent. carbon steel from 825 deg. C., and ageing for 50 days, gives to the steel superior mechanical properties. By this means a tensile strength of

42.5 tons per square inch may be obtained, with an impact value of 52.5 ft.-lb. The elongation and reduction of area are also fairly high. These values compare favorably with those of the 0.46 per cent. carbon steel AS 8 in the normalised condition. Age embrittlement of steel AS 5 after quenching from 700 deg. C., moreover, may be entirely counteracted by ageing at 100 deg. C. for 4 hours. The accelerated ageing produces increased hardness which is not associated with brittleness.

✦ ✦ ✦

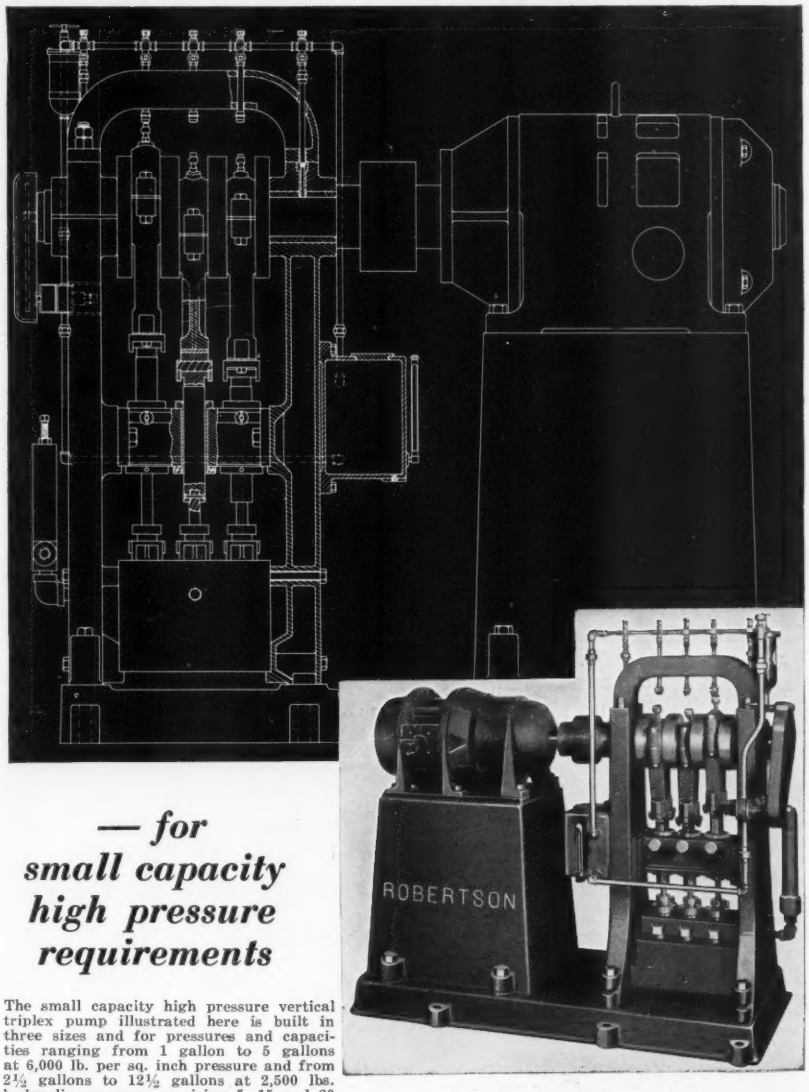
THE age embrittlement of low-carbon steel at atmospheric temperature, it is suggested, is due to some internal movement within the crystal lattice, which X-ray analysis has failed at present to identify. Precipitation would appear to occur at higher ageing temperatures, unaccompanied by brittleness. Embrittlement phenomena may occur in normal case-hardened specimens and the results obtained suggest the adoption of a hardening temperature of 800 deg. C. This should be followed, without exception, by tempering for a few hours at a temperature between 100 deg. C. and 200 deg. C., in order to obviate brittleness in the core.

By Arrangement With The Manufacturers' Committee of Reels And Spools Standardization

Reprints of the report of this committee as published in the November, 1934, issue of WIRE & WIRE PRODUCTS, outlining the proposed new standards for reels and spools for insulated wire and cable can be obtained for 25c a copy from

Wire & Wire Products
17 East 42nd St.
New York, N. Y.

DESIGNED *by* ROBERTSON



— for small capacity high pressure requirements

The small capacity high pressure vertical triplex pump illustrated here is built in three sizes and for pressures and capacities ranging from 1 gallon to 5 gallons at 6,000 lb. per sq. inch pressure and from 2½ gallons to 12½ gallons at 2,500 lbs. hydraulic pressure, requiring 5, 15 and 20 horse-power, direct-connected gear reducer motors respectively, connected by flexible couplings directly to the pump shaft.

All shaft and eccentric bearings are bronze-lined and lubricated automatically by an oil pump which delivers oil from a supply tank through an oil filter to shaft and eccentric bearings. Non-rust steel plungers operating in bronze guides, a solid forged steel pump chamber having large passages for water and a spring-balanced hydraulic safety valve complete the hydraulic end of a pump built for dependable service.

Send for literature.

Robertson makes all types of lead-encasing machinery required by manufacturers of rubber hose and electrical cables: Extrusion Presses, Hydraulic Pumps, Melting Furnace and Pot, Dies and Cores, Strippers, etc.

Are you receiving our little magazine, "Robertson Reminders"? If not, send us your name and address, and we'll gladly send it to you—regularly.

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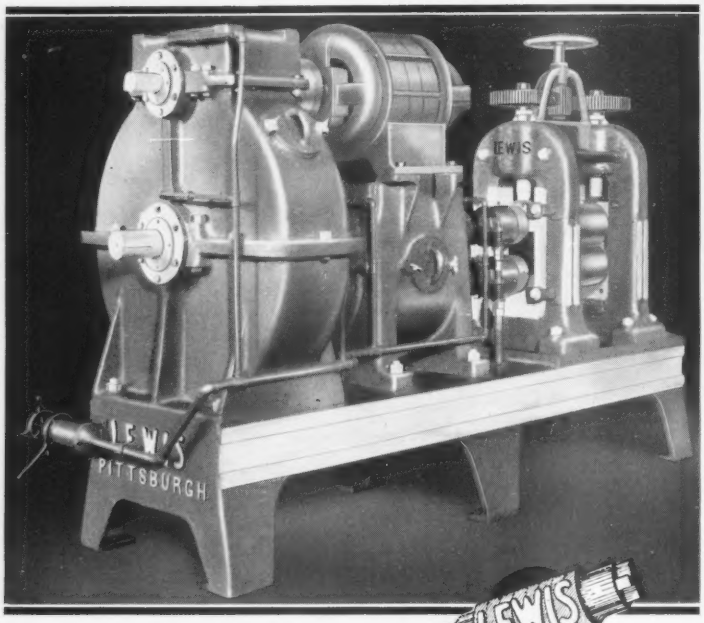
125-137 Water Street — Brooklyn, N. Y.

"It costs less in the long run"

LEWIS WIRE FLATTENING AND NARROW STRIP MILL



Unit Construction.

Lewis Cut Herringbone Gear Reduction Unit directly connected through a flexible coupling.

Forged Steel Pinions.

Bearings are lubricated by compression grease cups.

All gears run in oil.

Neck Bearings are die cast genuine babbitt or roller bearings.

Housings have T slots for attaching coilers and guide bars.

This Mill is built in a complete unit and can be moved at any time to any desired location in the plant. The rolls may be of any quality specified by customer, including hardened steel rolls, or water cooled rolls.

• • •

LEWIS MAKES A COMPLETE LINE OF ROLLING MILL MACHINERY INCLUDING:

Mill drives up to and including 6,000 HP. Shape Straightener Machines up to and including 24 inch I beam. Motor operated Screw-Down for Mill. High Speed Gear Sets for Continuous Rod Mills. Continuous Bar and Billet Mills. Cold Mills for Sheet and Strip. Rail Breakers. Rail Re-Rolling Mills. Universal Mill Spindles. Chilled Iron and Iron Alloy Rolls for Iron, Steel, Brass, Copper, Aluminum, Zinc and Nickel. For hot Sheets, tin plate and strip—for cold sheets, tin plate and strip. For merchant bars and rods, Shears—Vertical Alligator—Cropping—Plate and Squaring. Special Machinery—Testing Machines and Iron and Steel Castings.

PITTSBURGH, PA.

LEWIS FOUNDRY & MACHINE CO.

Sales Stimulators

(*Continued from page 149*)

AT the California State Fair at Sacramento the Columbia Steel Company had another interesting display of wire and wire products.

✦ ✦ ✦

MANUFACTURING nails at the rate of 450 a minute, a real nail machine attracted thousands of visitors in the Machinery Building. Most of the spectators at this operation had bought and driven many nails, but never before had they known how nails were made. An obliging operator accommodatingly answered all questions, and ran the machine slowly at intervals so that all present could see the method by which the nails were formed.

✦ ✦ ✦

THIS Nail Machine was taken from the Columbia Steel Company plant at Pittsburg, California, for exhibition in their booth.

✦ ✦ ✦

ANOTHER interesting feature of the Columbia Steel Company booth was the "Nail Tree" which consisted of a billet growing out of a base (which showed the material going into the making of the billet). This billet is regulation at the bottom, diminishing at the top into a standard piece of ten gauge wire, which was formed into a loop, the end of which was made up into several nails.

✦ ✦ ✦

IN the background was an interesting painting representing an artist's conception of a section of the San Francisco-Oakland Bay Suspension Bridge and various steel making operations. The display also included rolls of fence wire, reels of wire rope, a tray of nails showing all the different types of nails made in the Pittsburg, California plant of the Columbia Steel Company, samples of wire rope made in the San Francisco Pacific Works of the Company and a wire drawing block which was cast at the Pittsburg, California plant.

The Story of Wire

(*Continued from page 142*)

in the United States and Canada. Its research activities have spread to Belgium, France, Germany, Spain and Russia. Two years ago at the suggestion of the **Hon. Frederick H. Payne,** Assistant Secretary of War, the Wire Association, through a committee headed by **Mr. L. D. Granger,** Chief Metallurgist of the Wickwire Spencer Steel Company, undertook the compilation of a statistical history and up-to-date summary of the wire industry in America. Through the splendid work of **Mr. Granger, Major R. E. Brown, Spec. Res. Mr. K. B. Lewis and Mr. John Mordica,** a scientific statistical and technical survey of the wire industry is rapidly approaching completion. (See Fig. 9) Two years from now some ambitious student of Economic Planning will be able adequately to present **"The Story of Wire".**

✦ ✦ ✦

Part IV of this article will be published in the May issue of Wire & Wire Products.

✦ ✦ ✦

A New Mining Cable

A NEW cable with loom-woven sheath, for use on mining machines, reel locomotives, and other applications of a similar nature where the cable must withstand severe mechanical abrasion, is now available from General Electric.

✦ ✦ ✦

THE finish of this cable consists of a circular-loom-woven sheath, applied in a manner similar to the weaving of a carpet. Under this sheath is a layer of Glyptal cement, the sheath being so applied that is embedded in the Glyptal cement and partially embedden in the rubber insulation. This process results in a cable that is tough, extremely abrasion resisting, and, because of the Glyptal cement, highly resistant to oil, alkali, and acid.

MAKE YOUR PLANS NOW TO COME TO THE WIRE ASSOCIATION MEETING

SAMSON
Cold Drawn
HIGH CARBON STEEL SPRING WIRE
A Quality Product of Modern Metallurgical Art and Science

Possessing Uniformity in—
Tensile strength for loading capacity
Elasticity and resilience for spring action
Toughness and ductility for knotting and forming

Quality Insured by—
Scientific Control and Inspection
through all stages of manufacture
from the open hearth department
to the shipping department

SAMSON SPRING WIRE
is only one of the many grades of manufacturer's wire made and sold by

KEYSTONE STEEL and WIRE COMPANY
PEORIA ILLINOIS

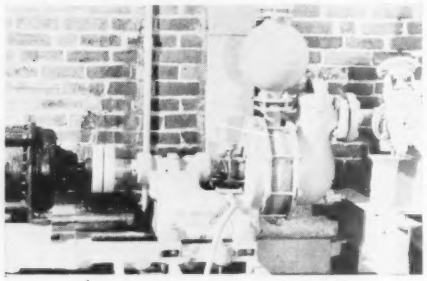
— DESCO —
A PICKLING STABILIZER ▲ ▲ ▲
FOR CARBON STEELS ▲ ▲ ▲

The strong passivating effect of this excellent inhibitor insures a bright finish and forms a sound basis for a bright drawing technique—

DELANY CHEMICAL CO.
COTTMAN AND MILNOR STS.,
PHILADELPHIA, PA.

DURIRON *is used by*

for unloading tank cars of Sulphuric Acid



Shown here is a Duriron self-priming pump, Type D2GS-9½, used for unloading tank cars of sulphuric acid, transferring the acid to storage tanks and from storage tanks to mixing tanks. The by-pass arrangement with the Duriron valve makes it possible to use this one pump for both purposes — an economical layout.

MERRIMAC CHEMICAL COMPANY
SUBSIDIARY OF
Monsanto Chemical Company
MC
BOSTON, MASS.

Naturally enough, these folks know acids and how to handle them. By using Duriron pumps, instead of air, they avoid dangers of explosion; blown gaskets, that cause acid to spray; excessive leakage of valves. Gain: No pressure on tank car or lines; valves easily kept leak-proof; constant presence of operator not required; power costs lower. Ask wire mills that are using them, or just write,

THE DURIRON COMPANY, Inc., 442 N. Findlay St., Dayton, Ohio

EFFICIENT PICKLING
REQUIRES "RODINE"

RODINE, SAVES ACID AND METAL

Prevents over-pickling. Minimizes acid brittleness and acid fumes.

Samples and Directions sent on request.

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Continuous Straightening and Cutting Machinery
With
FLYING SHEAR
for round and shaped wire.

✦ ✦ ✦

THE HALLDEN MACHINE COMPANY
THOMASTON CONNECTICUT

New Type Monel Metal

AFTER 12 years of research and development, engineers of The International Nickel Company have produced a new type of Monel Metal which combines the strength of alloy steels with the corrosion resistance of regular Monel Metal.

✦ ✦ ✦

THIS new alloy, known as K Monel, was announced at the recent meeting of the American Institute of Mining and Metallurgical Engineers by Dr. W. A. Mudge, metallurgist of the Huntington, West Virginia, works of the company where it was perfected.

✦ ✦ ✦

IN analysis the new alloy is practically the same as regular Monel Metal with the exception of about 4 per cent added aluminum and fractional amounts of other elements. It is readily heat treated and its fully hardened condition shows Brinell values above 350, though it is available also in softer forms. Its tensile strength runs higher than 160,000 pounds a square inch.

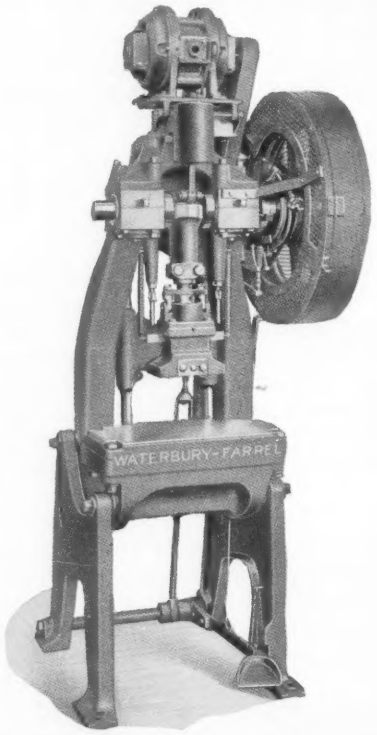
✦ ✦ ✦

Presses With New Type of Gate Guiding

THE **Waterbury Farrel Foundry & Machine Co.** of Waterbury, Conn., have just developed a new line of presses that embody a new type of gate guiding in the open-back press field.

✦ ✦ ✦

THE gate guide is obtained by clamping the gate to two chrome vanadium steel rods which slide in tapered bushings located above and below the tools. This gives an extra long guide to the gate and insures that the gate will be under control during the complete cycle of the press. The effect that this type of guide has on the tools is to cut the spring of the press in half at the point where the normal punch would contact the die. It is at this point where the



No. 44 size machine. ✦ ✦ ✦

real guiding qualities are needed, but this is impossible to obtain on the older type of "V" way open back press. The older type of press was constructed in such a way that the gate ran out of the ways when the bottom of the stroke was reached. This lessened the length

of the guide; and under the most favorable conditions the guide was not much longer than twice the width of the gate. This new line of presses maintains the same length of guide during the complete stroke.

✦ ✦ ✦

THESE presses have many other features that make them outstanding. They are furnished with a dash pot which prevents the gate from dropping when it goes over centers. This also allows the press to be run with less friction on the shaft and consequently means less heat in the bearings and less wear.

✦ ✦ ✦

THE shaft bearings are removable and may be redressed in the ordinary tool room. This applies to all the more vital parts of these presses. In other words, all of the repair work may be done in a tool room. This means that when the press has to be reconditioned it is not necessary to return it to the builder for this purpose.

✦ ✦ ✦

THERE is a new type ball and socket connection on these presses which is stronger and less apt to cause trouble. The ball is seated in a cast iron seat, but the pressure of the return stroke is taken on a steel plate which is connected to the seat through two links. This means, that the ball does not have to be necked in as much as the older type connection and as a result is much stronger. In the event of wear it may be taken up by simply grinding a little off two washers located under the return plate, then resetting the nuts.

✦ ✦ ✦

AN adjustable bar knock-out is located in the gate and may be removed if desired.

✦ ✦ ✦

THE presses are furnished with a capped gate and have very large tool space, permitting plenty of light on the tools. The machines are all inclinable to 35 degrees and may have tie rods. They can be furnished with back gearing from the No. 33 size up. The capacities run from 10 tons to 50.

Learn about PARALAN

Paralan will give your finished wire and wire products protection from atmospheric corrosion in the mill and in shipping. Paralan-coated wire can be spot welded or soldered without cleaning. Also, Paralan leaves surfaces in good condition for all types of finishes—enameling, japanning, lacquering, plating, etc.

Write for further information. We may be able to solve your difficulties.

AMERICAN LANOLIN CORP.
LAWRENCE, MASSACHUSETTS

ONE MAN TYPE TAKE UPS

Designed to handle reels from 60″ diam. up to 120″ diam.

NEW ENGLAND BUTT COMPANY

Office and Factory
304 Pearl St., Providence, R. I.

Western Office
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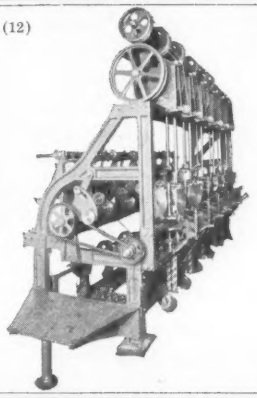
We build a complete line of Stranding Machines, Cabling Machines, Closing Machines, Rubber Strip Covering Machines, Measuring Machines, and Other Allied Machines for the Wire Trade.

OUR WIRE MACHINERY CATALOGUE SENT ON REQUEST

(12)



Vertical Model Taping Machine

Applies 3 tapes on each of six lines of conductor, either round or flat, and is equipped with wire straightening rolls and an individual traverse for each line of wire. Motor or belt drive.

EST. 1855 AIMCo INC. 1915
"American" INSULATING MACHINERY COMPANY
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Subsidiary of
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Broden Construction Co.
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CLEVELAND, OHIO

WIRE MILL EQUIPMENT
MORGAN CONSTRUCTION CO.
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RUESCH
Machinery For
Wire, Tube, And Brass Mills
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WIRE DRAWING MACHINERY AND EQUIPMENT
Rod Frames—16" Frames, 8" Frames —Take-Up Frames, Wire Pointers—Puller Tongs.
General Castings for Wire Mill use. Circulars on Request.
E. J. SCUDDER FOUNDRY & MACHINE CO.
TRENTON, N. J.

HIGH SPEED
Welding Wire Straightening and Cutting Machinery
Round Wire Straightening and Cutting Machinery
Flat Wire Straightening and Cutting Machinery
Roll and Rotary Wire Straighteners
THE F. B. SHUSTER CO.
New Haven, Conn.
Straightener Specialists Since 1866

VIANNEY
1882—Joseph Vianney establishes the first diamond die plant, in Trevoux. France.

Phelps Dodge Corporation Sells National Electric Products Corporation

PHELPS Dodge Corporation has sold one of its fabricating subsidiaries, National Electric Products Corporation to Mr. W. C. Robinson and associates of Pittsburgh.

✦ ✦ ✦

NATIONAL Electric Products Corporation is a successor to National Metal Molding Company with plant at Ambridge, Pa. Its business consists largely of steel conduit and other allied steel products. The company also does some wire business.

✦ ✦ ✦

PHELPS Dodge Corporation retains as its fabricating subsidiary, Phelps Dodge Copper Products Corporation, which was formed through the consolidation of American Copper Products Corporation, British American Tube Company, P-M-G Metal Company, Habirshaw Cable and Wire Corporation, and Inca Manufacturing Company.

✦ ✦ ✦

PHELPS Dodge Corporation found that conduit and allied steel products did not fit in with its copper business and therefore sold back to Mr. W. C. Robinson and his associates the National Electric Products Corporation which consists of the old National Metal Molding Company with plant at Ambridge, Pa.

✦ ✦ ✦

For
Exhibit Space
in the
Wire Association
Section
of the
National Metal Congress
Exposition
at Chicago, Ill.
Sept. 30 -- Oct. 1, 2, 3, 4
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The Wire Association
17 East 42nd St., New York, N. Y.

Kenneth B. Lewis
CONSULTING ENGINEER
Wire Mill Equipment, Layout and Practice
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Specializing in developing new wire products, manufacture of wire, insulated wire and high tension cable.
Standard and special equipments developed, built and installed. Any problem you may have, we solve it if you consult us.
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FOLDED PAPER FLATS
PAPER INSULATION YARNS
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EYELETS
ZINC WIRE
ZINC STRIP
THE PLATT BROS. & CO.
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BISCO
TUNGSTEN CARBIDE DIES
For Wire, Rod and Tubing
Round and Special Shapes
TUNGSTEN ELECTRIC CORP.
BISSETT STEEL DIVISION
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Wire Drawing Diamond Dies
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WIRE DIE CORPORATION
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For more complete information, consult the annual Directory, Index & Buyers' Guide.

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ANNEALING FURNACES
See Furnaces—Various Headings

ANNEALING POTS AND BOXES
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New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

BAKERS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

BORON CARBIDE—
Norton Co., Worcester, Mass.

CASTINGS—Wire Mill
E. J. Scudder Foundry & Machine Co., Trenton, N. J.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Delany Chemical Co., Tacony Station, Philadelphia, Pa.
Grasseli Chemical Co., Cleveland, O.

CLEANING & PICKLING EQUIPMENT
Broden Construction Co., Cleveland, O.
Duriron Co., The, Dayton, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Borden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.

CONDUITS—Iron and Steel
Youngstown Sheet & Tube Co., Youngstown, Ohio.

COPS—Paper
Manning Paper Co., John A., Troy, N. Y.

CRANES—Wire Mill
Cleveland Electric Tramrail Div., of Cleveland Crane & Eng. Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIES—Diamond
Association of Wire, Rod and Tube Die Mfgrs., Inc., New York, N. Y.
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Co., New York.
Driver-Harris Co., Harrison, N. J.
Kelly Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Cochaud Wire Die Corp., New York.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Vianney Wire Die Wks., N. Y.

DIES—Rod and Tube Drawing
Association of Wire, Rod and Tube Die Mfgrs., Inc., New York, N. Y.
Bissett Steel Co., Cleveland, O.
Carboloy Co., Inc., Newark, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Bissett Steel Co., Cleveland, O.
Kelly Wire Die Corp., New York, N. Y.

DIES—Tungsten Carbide
Bissett Steel Co., Cleveland, O.
Carboloy Co., Inc., Newark, N. J.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DRAW BENCHES
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

ENGINEER—Consulting Wire Mill
Lewis, Kenneth B., New York, N. Y.

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Platt Bros. & Co., The, Waterbury, Conn.

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E. W. Twitchell, Inc., Phila., Pa.

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Electric Furnace Co., Salem, O.

FURNACES—Automatic
Electric Furnace Co., Salem, O.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.

FURNACES—Electric
Electric Furnace Co., Salem, O.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.

FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.

FURNACES—Wire, Strip and Sheet
Electric Furnace Co., Salem, O.

GEARS—Wire Mill
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Lewis Foundry & Machine Co., Pittsburgh, Pa.

GRINDERS—Roll
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Norton Co., Worcester, Mass.

HANDLING EQUIPMENT—Material
Cleveland Electric Tramrail, Div. of Cleveland Crane & Eng. Co., Wickliffe, O.

HOISTS—
Cleveland Electric Tramrail Div., of Cleveland Crane & Eng. Co., Cleveland, O.

INHIBITORS
American Chemical Paint Co., Ambler, Pa.
Delany Chemical Co., Tacony Station, Philadelphia, Pa.
Grasseli Chemical Co., Cleveland, O.

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E. W. Twitchell, Inc., Phila., Pa.

INSULATING PAPER—For Magnet and Enamelled Wire
Manning Paper Co., John A., Troy, N. Y.

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Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—Pulverized
Amer. Lime & Stone Co., Bellefonte, Pa.

LUBRICANTS—Wire Drawing
R. H. Miller Co., Homer, N. Y.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
New England Butt. Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
Amer. Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Machinery Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Chain Making
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
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Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Coilers
Broden Const. Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester. Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cold Heading With Wire Drawing Attachment
Ajax Manufacturing Co., Cleveland, O.

MACHINERY—Copper Wire Drawing and Rolling
Farrel-Birmingham Co., Inc., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Halliden Machine Co., Thomaston, Conn.
F. B. Shuster Co., New Haven, Conn.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Forming
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Machinery Co., Phila.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Measuring Wire & Cable
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Machinery Co., Phila.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

BUYERS' GUIDE, Continued

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Lewis F'dry & Machine Co., Pittsburgh, Pa.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark. N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Inc., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila. Pa.
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Fidelity Machine Co., Philadelphia, Pa
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co.. Paterson. N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Const. Co., Cleveland, O.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley. Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.

MATERIAL HANDLING EQUIPMENT—
Cleveland Electric Tramrail Div., of Cleveland Crane & Eng. Co., Cleveland, O.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PAPER—Insulation
Manning Paper Co., John A., Troy, N. Y.

PAPER—Packaging (For Wire Cable)
Manning Paper Co., John A., Troy, N. Y.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Delany Chemical Co., Tacony Station, Philadelphia, Pa.
Grasselli Chemical Co., Cleveland, O.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Inc., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Encasing
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
E. J. Scudder Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Sleeper & Hartley, Inc., Worcester, Mass.

REEL CRUTCHES
Watson Machine Co., Paterson, N. J.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

RODS—Wire—Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

RODS—Wire—Steel
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

ROLLING MILLS—See Machinery—Rolling Mill

ROLLS—
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Lewis F'dry & Machine Co., Pittsburgh, Pa.

RUST PROOF COMPOUND
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Republic Steel Co., Youngstown, O.
Superior Sheet Steel Co., Canton, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

SOAPS—Wire Drawing
R. H. Miller Co., Homer, N. Y.

STRIP—Brass, Zinc and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

STRIP—Steel
Continental Steel Corp., Kokomo, Ind.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.

VULCANIZERS
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS
American Insulating Mach'y Co., Phila., Pa.

WIRE—Enameled For Coils
Winsted, Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Continental Steel Co., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Company, Ossining, N. Y.

WIRE—Non Ferrous to Specification
Hudson Wire Co., Ossining, N. Y.
Winsted, Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Continental Steel Corp., Kokomo, Ind.
Keystone Steel and Wire Co., Peoria, Ill.
Republic Steel Co., Youngstown, O.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Brass, Zinc
Platt Bros. & Co., The, Waterbury, Conn.

This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.

THE WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

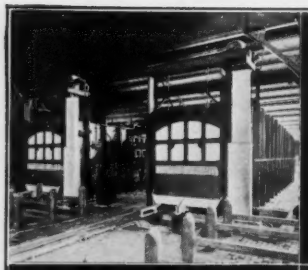
Electric Cable and Wire Rope Machinery:

STRANDERS	Planetary & Rigid Frame types (*horizontal and vertical.*) High-Speed Tubular and Built-up types.
BUNCHERS	High-speed types for spools up to 1500 lb. capacity.
ARMORING MACHINES	For Wire (*planetary type*) and for Tape.
PAIRING & TRIPLING MACHINES	For Bare & Insulated Wire.
CLOSERS	For Wire in Planetary, High-speed & Angular types.
CLOSERS & CABLERS	For electric cable in Planetary and Angular types.
TAPING MACHINES	Eccentric and Concentric types, for Paper, Friction and Varnished Cambric and Burlap types.
TAPING HEADS	For applying steel tape in Eccentric and Concentric high-speed types.
JUTE & BURLAP	Applying Heads.
THREAD SERVERS	For Cotton, Asbestos, etc. application on hose and wire.
COMPOUND TANKS	Electrical or Steam heated for machine or unit application.
CHALK APPLIERS	Wet and Dry types.
CAPSTAN SECTIONS	With Single tapered and double grooved wheels, with Lay Control by gears or variable speed transmission.
LET OFF REEL STANDS	Shaft and Shaftless types, for any size of reels.
WINDERS	For steel and copper, in single or multiple head units.
COILING MACHINES	Power or manual drive for package coiling—also for warehouse and shipping room use.
COILING HEADS	For wire rope and insulated wire and cable.
TAKEUP STANDS	Inclined frame, Shaftless and Heavy-duty types.
TRAVERSES	Light and Heavy, manual, mechanical and motorized.
TEMPERING & GALVANIZING MULTIPLE HEAD TAKEUPS	For wire.
MEASURING MACHINES	For Length Measurement.
ELECTRIC PATCH VULCANIZERS	
SATURATING, WAXING & GREASING TANKS	Gas fired and Electrical.
WIRE TINNING MACHINES	Gas fired and Electrical.
CABLE PEELERS	For removing lead sheathing and insulation.
POLISHING HEADS	Separately or Motor driven.
REEL CRUTCHES	For turning heavy reels in handling and shipment.
MOTORIZED WINCHES	For general duty in cable and rope plants.
CUTTERS	For wire rope, cable and chain.
SPOOLS	Heavy-duty for Rope-Mills and Cable-plants.

Send for descriptive catalogue.

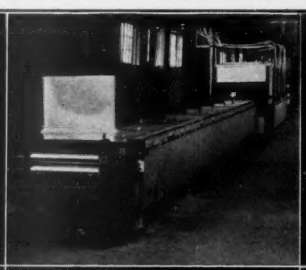
ELECTRICAL WIRE AND CABLE—WIRE ROPE AND CORDAGE MACHINERY

We Build the Furnace To Fit Your Job



Annealing 47-ft. Tubing

Steel tubing 47 ft. long is uniformly and economically annealed in the two car type furnaces shown at left. These furnaces are similar to the battery of seven car-bottom furnaces we built two years ago.

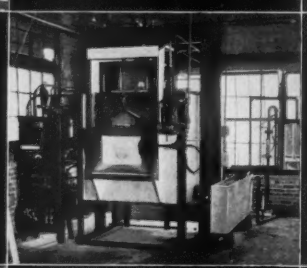


Bright Annealing Steel Strip

Cold rolled steel strip up to 24" wide is bright annealed in the continuous electric furnace shown at left—one of our new developments in controlled atmosphere furnaces.

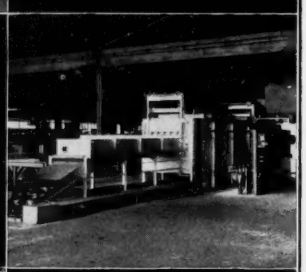
Copper Brazing Furnaces

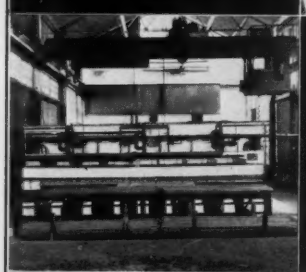
Metal parts are joined neater, cheaper and stronger in this furnace. We build these furnaces in continuous, semi-continuous and batch types. Get our leaflet describing this process.



Bright Annealing Copper Tubing

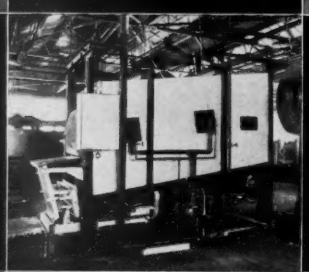
Copper tubing in coils up to 30" in diameter and in lengths up to 35' is bright annealed continuously in this new controlled atmosphere furnace—the tubing comes out bright, clean and dry.





Continuous Pipe Annealing Furnaces

The illustration at left shows charging end of a continuous pusher-type gas fired furnace, designed and built by our Fuel Division for annealing pipe up to 23 ft. in length.

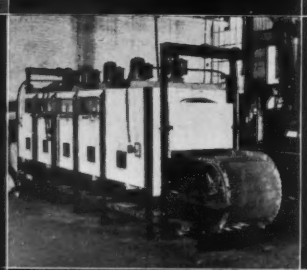


Continuous Forging Furnaces

This pusher type furnace heats and delivers slugs—one at a time—at just the right temperature, height and speed for the operator. This is the 24th furnace we have built for this concern.

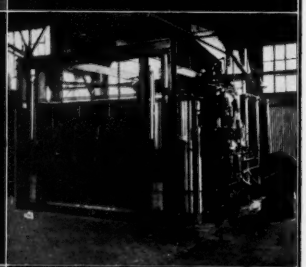
Belt Conveyor Furnaces

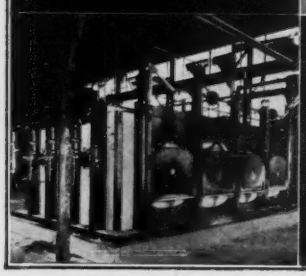
This continuous furnace—just completed—is the fifth belt conveyor type furnace we built for this company.—Get our bulletin showing these furnaces—ask for bulletin No. 4-30.



Heating Stainless Steel Billets

Oil fired hearth-type furnace heating stainless steel billets in a mid-west plant, produces an atmosphere ideally suited for this work—an exact duplicate of a furnace we built for them about a year ago.





Heats Billets For Rolling

This four door, oil-fired furnace heats stainless steel ingots and billets, prior to rolling, in a prominent eastern plant. A similar six-door furnace was also built for this concern.

Enameling Furnaces

Refrigerator and other parts are enameled in this batch type electric furnace. We also build enameling furnaces in semi-continuous and continuous types—electric or fuel fired.

THE ELECTRIC FURNACE CO.

SALEM, OHIO.

Fuel Fired Furnaces

Electric Furnaces